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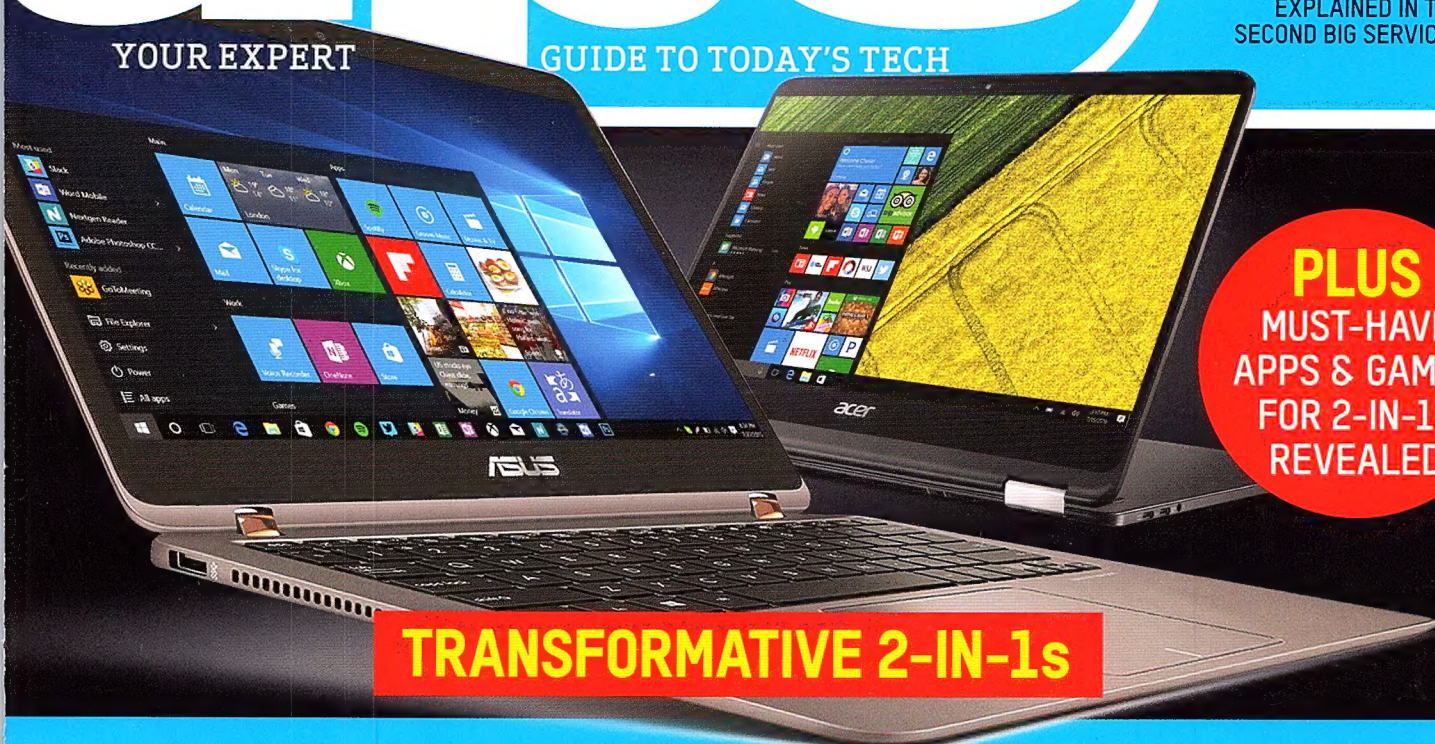
June 2017
Issue 442

WIN 10 CREATORS UPDATE!

ALL THE BEST NEW BITS
EXPLAINED IN THIS
SECOND BIG SERVICE PACK

YOUR EXPERT

GUIDE TO TODAY'S TECH

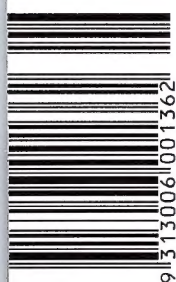


PLUS
MUST-HAVE
APPS & GAMES
FOR 2-IN-1s
REVEALED

TRANSFORMATIVE 2-IN-1s

CHANGE THE WAY YOU COMPUTE

ROUNDED UP & PUT THROUGH THE RINGER: THESE TABLET/LAPTOP HYBRIDS PROMISE THE BEST OF BOTH WORLDS — BUT WHICH ONES ARE REALLY UP TO THE TASK? FIND OUT INSIDE!



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Future

PLAIN ENGLISH TECH TUTORIALS

- STREAMLINE WINDOWS 10
- TURN YOUR HOME PC INTO A PERSONAL VPN SERVER
- SPEED UP AN OLD MAC WITH A NEW MAC-LIKE OS
- HOW TO USE BLU-RAY ON LINUX

NEW PCs, PARTS & GEAR REVIEWED

- RYZEN GETS CHEAPER: AMD'S CHEAPER 5-SERIES ON TEST
- ASUS GAMING ULTRABOOK: PETITE BUT GRUNTY
- CORSAIR'S ONE DESKTOP PC: THE ONE FOR YOU?

BUILD A RYZEN PC ON A (REASONABLE) BUDGET

GET GOING WITH AMD'S HOT NEW HIGH-END PLATFORM WITHOUT BREAKING THE BANK — DETAILED SPECS & GUIDE IN THIS ISSUE!

SEE
PAGE 92



Advanced Business Network Multi-WAN Solution for NBN Fast, Secure & Reliable

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Aust & NZ
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Vigor3900

Quad-WAN Gigabit broadband router with Security Firewall, 500 x VPN tunnels, and 100 x SSL-VPN tunnels



- 4 x Gigabit Ethernet WAN ports
- 1 x SFP WAN port
- Multi-WAN Load Balancing & Failover
- 2 x Gigabit Ethernet LAN ports with 120,000 NAT sessions
- 1 x SFP LAN port
- 500 x VPN & 100 x SSL-VPN tunnels with Central VPN Management
- High Availability Mode
- Object-oriented Firewall with Content Security Management (CSM) and QoS
- IPv6 x IPv4
- Multi-subnet WAN/LAN through 802.1Q
- Bandwidth management
- 2 x USB ports for 3G/4G LTE mobile broadband access, USB printer, storage, and thermometer
- Support VigorACS SI management system
- Smart Monitor Traffic Analyzer (up to 500 nodes)

Vigor3220 Series

Quad-WAN Gigabit broadband router with Security Firewall, 100 x VPN tunnels, and 50 x SSL-VPN tunnels



- 4 x Gigabit Ethernet WAN ports
- 1 x USB port (USB3.0) support 3G/4G LTE mobile broadband access
- Multi-WAN Load Balancing & Failover
- 1 x USB port (USB2.0) support file sharing, external storage, network printer or thermometer
- 100 x VPN and 50 x SSL-VPN tunnels with Central VPN Management, Load Balance and Redundancy
- 1 x Gigabit LAN port with 100,000 NAT sessions
- 1 x Dedicated Gigabit Ethernet DMZ port for connecting servers
- 1 x Console port (RS232)
- Object-oriented Firewall with Content Security Management (CSM) and QoS
- IPv6 x IPv4
- 802.11n Wi-Fi for Vigor3220n
- Central AP Management
- Central Switch Management
- Support VigorACS SI management system
- Smart Monitor Traffic Analyzer (up to 200 nodes)

Vigor2952P

Dual-WAN broadband Fibre router with Security Firewall, 4 x PoE LAN ports (power budget up to 60 Watts), 100 x VPN tunnels, and 50 x SSL-VPN tunnels



- 1 x Gigabit Ethernet/SFP combo WAN port
- 1 x Gigabit Ethernet WAN port
- Multi-WAN Load Balancing & Failover
- 4 x Gigabit LAN ports with 60,000 NAT sessions
- Complies with 802.3at PoE Plus
- PoE power up to 30 watts for each port
- Total PoE power budget up to 60 watts
- 1 x USB port (USB3.0) support 3G/4G LTE mobile broadband access
- 100 x VPN and 50 x SSL-VPN tunnels with Central VPN Management, VPN Load Balance and Redundancy
- High Availability Mode
- Object-oriented Firewall with Content Security Management (CSM) and QoS
- IPv6 x IPv4
- 1 x USB port (USB2.0) support file sharing, external storage, network printer or thermometer
- Central AP Management
- Central Switch Management
- Support VigorACS SI management system
- Smart Monitor Traffic Analyzer (up to 100 nodes)



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FIPP



How to choose a good VPN

APC's editor explains what you need to look
for when selecting a VPN service provider.

Australia's much-maligned
metadata retention laws
are now in full effect,
meaning your ISP (and
your phone-service provider) is
obliged to collect and store certain
pieces of information regarding
your digital communications –
including things like who you've
sent messages to and what websites
you've visited. That data will be
kept for two years and can be
accessed by approved government
agencies without a warrant.

That's a development that's seen
a surge in demand for VPNs in
Australia. VPNs protect you from
this 'dragnet' approach to metadata
collection by cloaking all your online
activities – when you're connected to
a VPN, all your internet traffic is first
routed through your VPN provider's
external network – effectively
meaning that only that VPN provider
knows what sites and services you're
connecting to.

But with hundreds of options
available, finding one that's good can
be tough. If you're mostly concerned
about privacy, picking an overseas-
based provider is a fairly safe first
step. Once you've got some on your
shortlist, we'd recommend checking
the rather exhaustive chart at That
One Privacy Site (thatoneprivacysite.net/vpn-comparison-chart), that
includes a rundown of where each
VPN is headquartered, what logging
laws it complies with and even some
limited speed-testing.

The problem with overseas-based
global VPNs – even the ones that

lease local Australian server
infrastructure through which to
route traffic (and theoretically give
users faster and fatter speeds) –
suffer from varying performance.
That can happen if a VPN becomes
too popular and doesn't add more
servers and bandwidth. We'd suggest
not signing up for extended plans
and sticking with month-to-month
subscriptions – unless you're happy
to accept the risk. Regardless, before
choosing a VPN, you should always
sign up for a free trial and, during
that period, frequently test your
speeds using **Speedtest.net**.

If you want to go with an Aussie
company, which can help guarantee
speeds and service, you need to be
a bit more wary. There's still some
question over whether VPN operators
in Australia need to comply with the
metadata retention laws – and
different companies take different
stances. A literal reading of the laws
seems to imply that only "carriers or
carriage service providers" – ISPs –
need to collect metadata, and as such
some VPN providers don't, but some
do, so be sure to check. But stay tuned
– we'll be checking back in on the
VPN category later in the year with
our own review round-up! ■



DAN GARDINER
EDITOR-IN-CHIEF
dan.gardiner@futurenet.com

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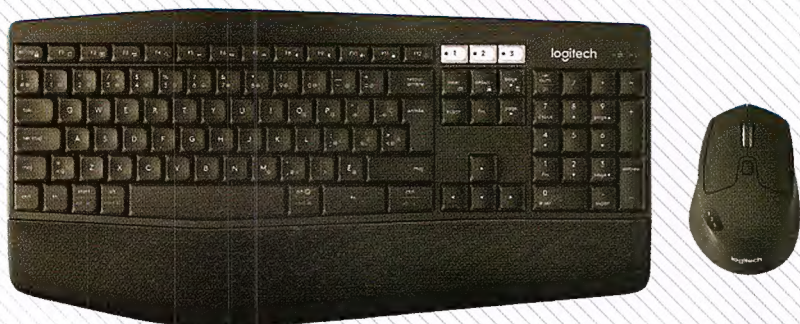
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PAGE FOR YOUR
EXCLUSIVE FREE
SOFTWARE
OFFERS

exclusive software

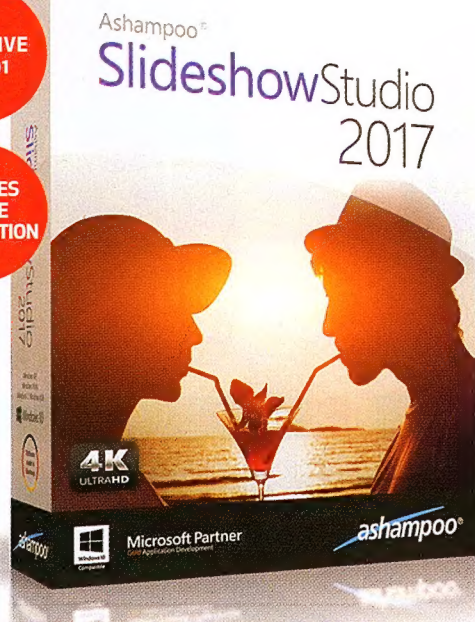
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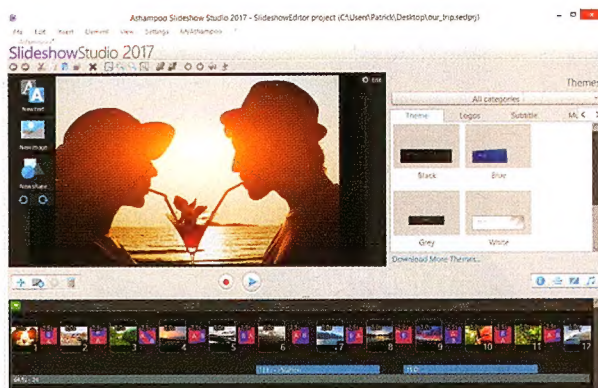
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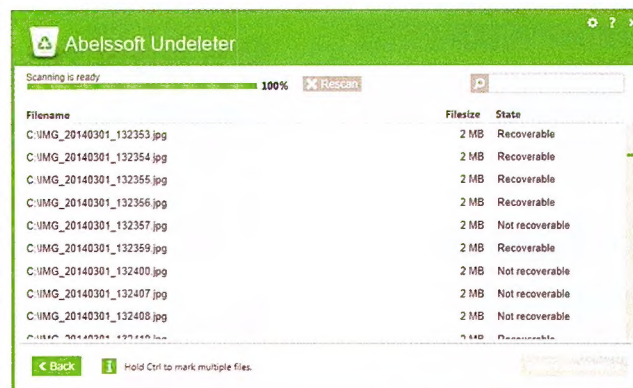
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the lab » content name

the lab

» LATEST REVIEWS

AMD Ryzen 5 1600X

Taking AMD's new hexa-core hotness for a spin.

LABS BENCHMARK RESULTS

Category	Score
Overall	22.0
Single-core	15.0
Multi-core	15.0

© 2017 AMD

When AMD pulled the wraps off its radical new Ryzen CPU, it was all about those eight awesome cores. Count 'em, Intel. The first Ryzen 7 chips blew the market for \$600-plus CPUs wide open. But not everybody can unload that kind of money on a processor, especially a brand new design that also requires a motherboard upgrade. Enter the Ryzen 5 1600X. On paper, it might just be the ultimate balancing act between performance bang and efficient deployment of your hard-earned buck.

The 1600X packs six cores and supports 12 threads, while a similarly priced Intel processor, the Core i5-7600K, has four cores and just four threads. And as a consequence of being the top six-core model, it also clocks in at 3.6GHz nominal and 4.0GHz turbo. It looks like a very nicely balanced chip. And for \$299, it's the mid-range CPU that we've all been waiting for, right?

For the most part, yes. When it comes to outright multithreaded performance, it pips a cap in the head of the Intel Core i5. The Core i5-7600K manages 663 in Cinebench. The Ryzen 1600X? A massive 1,223 points, nearly double the Core i5's capability.

Admittedly, the Core i5 retains some dignity in the single-threaded version of Cinebench, with 179 points compared to the 1600X's 159 points. However, the AMD chip looks like the better trade-off at first glance. Elsewhere, if the results aren't quite as spectacular, AMD still chalks up some decent wins. It cratches high-quality video encoding at 22fps to the Core i5's 18fps, and it motors through the Fry Render benchmark in just 2 minutes and 46 seconds — two minutes faster than the 7600K.

If you want a CPU for content creation or any workload that majors on parallelism, this isn't a race. The Intel competition is hideously, hopelessly outclassed. That's true even taking into account the fact that the Ryzen CPU is a little more power-hungry. An extra 10 watts at the wall is surely worth it.

Where the Ryzen is a little less compelling is in the games area. When it comes to average frame rates, the 1600X delivers on that 40Hz promise. The subjective experience, however, tells a slightly different story. Total War: Attila is a great case study. Running on the Intel processor, it's super smooth, whether you're up in the sky, landing it over your troops, or down in the thick of the action. But with the Ryzen CPU at the same settings and using the same video card, there's juddering almost everywhere.

There are a few reasons why. We used an Nvidia GPU, and there are at least indications that the Nvidia driver is poorly optimised for Ryzen. There are also question marks surrounding Ryzen's basic architecture, which is composed of a pair of quad-core modules.

Some latency is involved in communicating between the two quad-core modules, and that can require careful management by both OS and application to avoid performance penalties. Ryzen is brand new, so most software has yet to be tweaked to take account of such issues. Of course, most software runs OK without any modifications.

On a final note, like other Ryzen processors, the 1600X has pretty much zero overclocking headroom. AMD has these things running pretty ragged. An additional 100MHz was the best we could achieve.

in Jeremy Labad

Verdict
Features ★★★★★
Performance ★★★★★
Value ★★★★★

Their core design makes this an appealing choice in terms of cost-per-core, but this isn't for game devs.

Apple iPad (2017)

ASUS Tinker Board

Sapphire Radeon RX 580 Nitro+

Inside APC

Find out all about APC's editorial policies, test practices, how to read the benchmark results and more.

APC is Australia's oldest consumer technology magazine — having been consistently in print for over 35 years, since our first issue way back in May 1980 — and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer — it's in our name, after all — the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And like you, APC's journalists want to know what's good in tech — no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives — the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, APC still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule and where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.



Windows 7 and 8.1 updates blocked on certain CPUs

LATEST HARDWARE NOW KILLS UPDATES ON OLDER VERSIONS OF WINDOWS

If you've built a lovely new Ryzen or Kaby Lake system, and stuck with Windows 7 or 8.1, there's a catch. According to a Microsoft Knowledge Base article, Windows Update now informs you that you have unsupported hardware when you try to update. The solution, naturally, is an upgrade to Windows 10. The cited reason is Microsoft's 'support policy'. We knew this was coming — last year, Microsoft said that Windows 10 would be the only platform to support Kaby Lake, Qualcomm 8996 and AMD Bristol Ridge. Not many people will be running the latest chips alongside older versions of Windows, so adding support would be unprofitable. But cutting off all updates does look mean-spirited. Older versions of Windows run perfectly well on new silicon; there's no technical problem. This move leaves you out in the cold; you won't even get basic security updates. Boo. CL

Aussie ISPs forced to block a number of KickassTorrents related sites

CAN THE RIGHTS HOLDERS SHUT THEM DOWN FASTER THAN THEY CAN MULTIPLY?

Another cluster of domains has been added to the ever-growing list of piracy websites that Australian ISPs are forced to block. The latest additions include an array of sites associated with the popular KickassTorrents name, including proxies and mirrors, and were this time brought to attention by a number of music labels. This ruling will allow rights holders to submit an affidavit in the future in order to get any further domains blocked, rather than having to go through the same legal proceedings. HD



Microsoft announces its Chromebook killer: the Surface Laptop

Colourful, sophisticated and velvety.

Anounced at a recent event in New York, Microsoft's newest product, the Surface Laptop, brings yet another slick PC to the company's ever-growing stable. The product is said to be the tech giant's answer to the MacBook Air and cheap Chromebooks flooding US the market.

The Surface Laptop packs a 13.5-inch PixelSense display with a 'flocked Alcantara' material — that's the same microfiber fabric found on some Surface keyboard covers — surrounding its keyboard and trackpad. It comes with your choice of either an Intel Kaby Lake Core i5 or i7 processor and, in a laptop first, has a PCIe SSD mounted directly on the motherboard (up to 512GB). Out of the box, it'll run a new lightweight version of Windows called Windows 10 S which can be upgraded to Windows 10 Pro for just US\$49 (about \$65).

Starting at \$1,499, the Surface Laptop will arrive in Australia on June 15th, 2017, and will be available in Platinum, Burgundy, Cobalt Blue and Graphite Gold. Stephen Lambrechts

Australian Federal Police admit to illegally accessing journalist's call records

ALL IN THE NAME OF INVESTIGATION.

The Australian Federal Police recently admitted that an officer accessed a journalist's phone records without a warrant to investigate a leak from within the AFP. The breach occurred earlier this year and an internal investigation was carried out, but no disciplinary action was taken against the officer. Commissioner Andrew Colvin defended the action, saying he didn't believe there was any "ill will or bad intent".

The matter was recently raised with the Commonwealth Ombudsman, who promised an audit, but the journalist wasn't informed of the breach. Commissioner Colvin stated that only the call records were accessed, not the content of the calls themselves, "Just the fact of the existence of the calls in the first place."

To allay public fear on the growing concern over metadata retention, the Commissioner said, "I believe that the public should have full confidence in the police... and this [metadata retention] policy... I want to underscore how important access to metadata is to police as a fundamental building block of our investigations." Sharmishta Sarkar



eBay may block Australians from international purchases

PROPOSED GST COLLECTION THRESHOLD CHANGES TO BLAME.

eBay Australia says it may prevent local buyers from purchasing goods from international sellers, if the government's proposed GST changes go ahead. Those changes would force all online sales to incur the additional 10% charge that already applies to local purchases, and would attract different categories and formats of tax if the goods land above or below the \$1,000 threshold — a complexity that eBay isn't happy about. **HD**

Google may integrate ad-blocking directly into Chrome

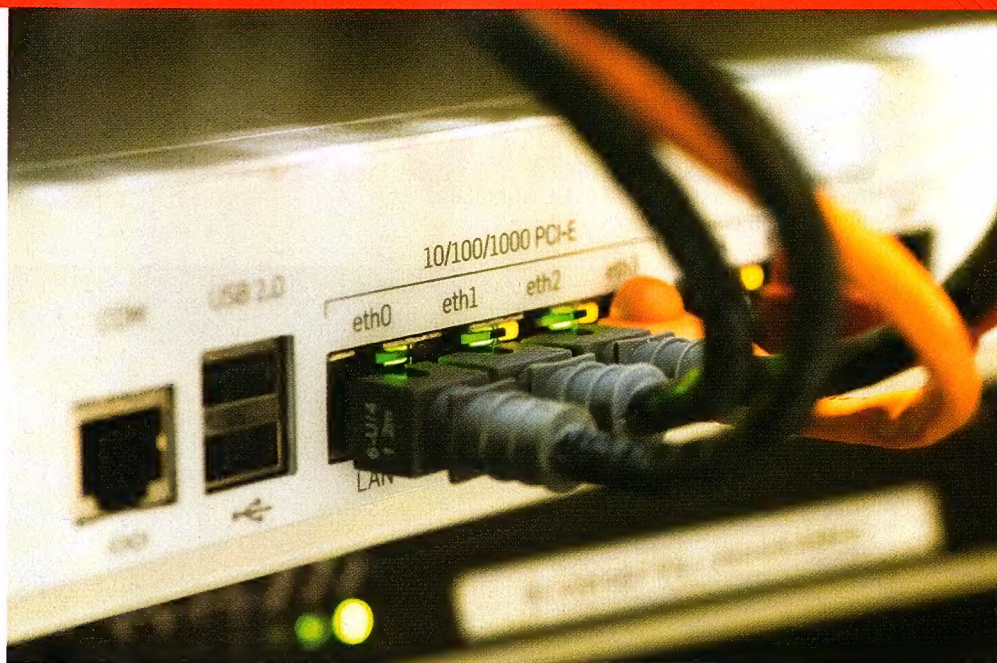
CLEANING UP THE WEB, OR CREATING AN AD-REVENUE MONOPOLY?

According to a report in the *Wall Street Journal*, Google is planning to integrate its own ad-blocker into its Chrome browser. In a worst-case scenario, this could conceivably allow Google to create a monopoly on online ads, in which only Google Ads will be acceptable. More likely is that the tech giant wants get ahead of the uptick in users adopting ad-blocking software. Only time will tell. **SL**

It's official: Amazon will launch retail services in Australia

RETAIL EMPIRE EXPANDS ACROSS THE PACIFIC.

While there've been many hints that Amazon has been planning to bring its retail services to Australia for some time, we've finally got official word from the online giant about its intentions for the AU market, although there's no firm dates yet. Amazon already employs 1,000 staff to work for its Web Services and Kindle store, and further callouts have recently been made to staff its grocery service AmazonFresh. **HD**



Revised NBN rollout plans bring more fibre to the curb

Though it'll be too little, too late for some.

The NBN installation plan is an ever-changing beast, with adaptations and adjustments at every turn of its rollercoaster of a rollout. The latest change involves applying fibre to the curb (FttC) connections to an additional 300,000 premises that would have otherwise relied on the more widespread fibre to the node (FttN) infrastructure — FttC relies less on existing copper cabling in the connection, which essentially translates to greater potential network speeds.

The number of FttC installations has grown significantly since the Multi-Technology Mix (copper and fibre) solution was first proposed, rising from an initial 300,000 to 700,000 when NBN Co recently scrapped plans to use \$800 million worth of Optus HFC cabling it had purchased five years earlier. With this latest adjustment, a total of 1 million premises will end up with the superior FttC connections, and that number may increase further as the rollout continues and specific regional plans are finalised.

Almost 5 million premises are already NBN-ready, according to the latest NBN Co progress report, and the national infrastructure rollout is still expected to be completed sometime in 2020. **Harry Domanski**

Australian Government wants ISPs to protect public against online threats

WHO SHOULD BE RESPONSIBLE FOR YOUR ONLINE SAFETY?

The Australian Government's Dan Tehan, the Assisting Minister for Cyber Security, has recently made comments claiming that the job of protecting your digital interactions should be up to your ISP. In a column in *The West Australian* newspaper, Tehan wrote that "we need to be able to trust telecommunications companies to protect our information from threats", and that "the onus is on these companies to develop products to stop their customers being infected with viruses".

While there's currently no suggestion that these comments outline a plan for legislation, they may signify the intention of the Government, given the similar nature of comments made by Prime Minister Turnbull in recent weeks, in which he has urged telcos to do more on this issue. Mr Tehan did not make any suggestions as to how ISPs might bear the costs of implementing this increased level of cyber security, or whether they should be passed on to the end user — something which could make internet access costs higher for Australian consumers. **Harry Domanski**

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS

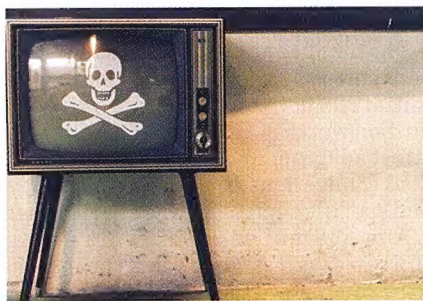
A photograph of a man wearing a dark hat and a white t-shirt, sleeping peacefully on a wooden bench. He is inside a green vehicle, possibly a bus or train, with a window showing a blurred outdoor scene. Large white text '2 years' is overlaid on the bottom left of the image.

At his talk at the TED 2017 conference, tech mogul Elon Musk unveiled plans for building a new subterranean traffic system and answered a number of other questions on the future of transport. When questioned on autonomous vehicles, Musk seems to think we're only about two years off being able to safely nap in our self-driving cars and, given the pioneering exploits of Musk's Tesla Inc. in this field, this bold claim could be closer to reality than it may seem.



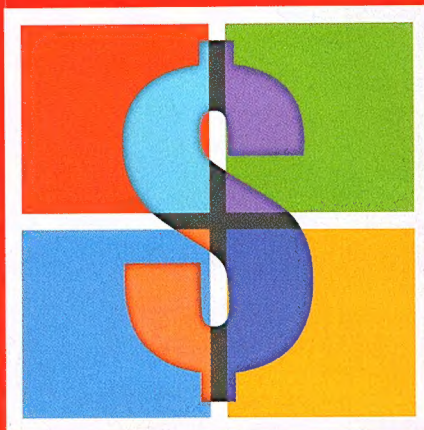
NUMBER OF SCANNED BOOKS
IN GOOGLE'S DATABASE, WHICH THE
COMPANY CAN'T MAKE PUBLIC
DUE TO COPYRIGHT.

Google's project to digitise a near-exhaustive list of global literature began in 2002 and ended in 2011 before it was released to the public, as the project was legally deemed to be in breach of copyright laws by US courts. This means that there are now over 25 million digital books (as searchable and copy-pasteable as web pages) sitting on around 50 petabytes worth of drive storage somewhere on Google's premises, all just waiting for legal authorisation to flick the switch.



PERCENTAGE OF US MILLENNIALS WHO STREAM PIRATED TV SHOWS AND FILMS

A survey conducted by market researchers Launchleap has found that Americans aged 18–35 are more likely than not to stream pirated video content. 53% of respondents owned up to getting their shows this way, and 93% of these respondents didn't feel guilty about doing so. That's perhaps due to the fact that 70% of those surveyed also streamed content legally, via services such as Netflix, suggesting that millennials are happy to pay for fairly-priced content — but perhaps not for multiple services or just to watch exclusives.



US\$292 million

Microsoft earnings have dipped in the last quarter, with the company claiming the sluggish performance is due in part to the "lower than expected" sales of its Surface units, which saw a revenue drop of 26% or US\$292 million compared to the previous quarter. Defending the shift, Microsoft has suggested increasing competition in the 2-in-1 market has had an impact and the company is hopeful that the next quarter will see improvement thanks to the release of new Surface products such as the Surface Studio and Surface Laptop.

[illegible]

THE PERCENTAGE OF AUSTRALIAN
CYBER ATTACKS THAT ORIGINATE
FROM WITHIN OUR OWN COUNTRY.

In a recent report published by NTT Security, a massive 86% of all cyber attacks targeting Australians over a 12-month period actually originated from within the country, while a further 9% were from the US. The vast majority of hacks were achieved via remote administration or file sharing, with around 40% of the total attributed to each method, and around 93% of the overall attacks utilised a Trojan to gain access to the victim's sensitive data.

techbrief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK



Fighting the fakes (Round Two)

The quiet(ish) rebellion forming against the post-truth world.

The spread of misinformation or 'fake news' has become an alarming trend over the past couple of years — though we acknowledge that it's not a new phenomenon. The surprising results of the Brexit vote and Trump election have widely been criticised as having been influenced by fake news or deliberately spread misinformation (for instance, Nigel Farage's UKIP pledge to give £350M to the National Health Service, and Trump's claim that Barack Obama had founded ISIS). Now, with the upcoming French presidential election — featuring social-liberal candidate Macron and right-wing nationalist Le Pen — as well as the UK general election, all eyes will be glued to the major players in online media distribution to see whether they have any new tools on their belts to prevent the spread of fake news — or at least increase awareness of it.

Wikipedia-founder only wants to publish truth in new journalism project

Jimmy Wales, founder of Wikipedia, is again looking to make waves with a new potentially world-changing project. WikiTribune is Wales' attempt to create "a new kind of news platform", adding together the community and journalism to produce easily-verifiable facts for free. While 'evidence-based journalism' shouldn't be a thing — rather a given — Wales believes that news as we know it is 'broken' and that we need to fix it. In the crowdfunding stage at present, the project already had more than 8,000 supporters pledging to the cause, and we're quietly hoping this project gets off the ground.

University teaches how to call bullshit (and you can stream the lecture online)

We're not joking with that headline — the course in question is literally titled 'Calling Bullshit' and its outline went viral soon after being posted to the University of Washington's website. This move by the uni to enlighten its students goes beyond just identifying fake news; it can also be applied to many other avenues of life, particularly professions reliant on raw data analysis. At the time of writing, the first lecture was available on YouTube. Perhaps this sort of 'general awareness' teaching could be introduced into our school systems instead of, say, religious education... (Please direct your complaint letters to the Editor.)



Facebook finally takes fakes seriously

Despite Mark Zuckerberg insisting that "over 99% of what people see [on Facebook] is authentic", the social-network CEO seems to have finally realised that social media's role in spreading it is not "a crazy idea" after all. In the wake of revelations about Russian involvement in the recent US election, Facebook has ramped up its stance against the attempts of some to "manipulate civic discourse and deceive people". As well as boosting its own security, the social media company is reportedly going to work closely with officials overseeing elections and to "notify and educate" its users with regards to what it labels "inauthentic" communications tarnishing its space.

Google's retooled search algorithm aims to cull contentious content

As one of the big players in media distribution, Google has copped a lot of flack in the wake of Brexit and Trump with regards to their inaction — or sometimes even promotion — against factually incorrect sources. The search giant's 'Project Owl' is its attempt to try to change that. To prevent the appearance of problematic search results (often due to user manipulation), Google is rolling out a reporting system to glean feedback from the community about its autocorrection search service. The company is also improving its Featured Snippets section (the 'We at Google think this is what you're looking for' elevated search result), as well as improving their search results quality overall.



technotes

» GEAR WE WANT

OAXIS INKCASE

\$129 | SHOP.OAXIS.COM

Reading books and long articles on your backlit smartphone screen is more taxing on the eyes than it is on an e-reader, but it can be difficult to keep an E-Ink screen with you at all times. Or at least it was, before the Oaxis InkCase. This clever iPhone 6, 6s and 7-compatible case adds a Bluetooth-connected 4.3-inch E-Ink display to the back of your smartphone, allowing you keep a library's worth of comfortable reading in your pocket. With the added ability to display a grayscale photo of your choice, the time, local weather, personal calendar info, upcoming events and your Apple health info, this is a pretty nifty and informative backpack for your smartphone. **JB**



GOPRO KARMA

\$1,350 | GOPRO.COM



After a false start due to some faulty battery tech, GoPro has finally relaunched its photo- and video-focused GoPro Karma drone Down Under. With battery life lasting only 16–20 minutes, flights may have to be curbed a little prematurely, but the overall body size (which is especially compact when folded) and the ability to use a gimbal-mounted Hero5 will go some way to make up for this lack of longevity. It's also certainly not the cheapest option, at \$1,350 for the drone and a 2.4GHz wireless controller, or \$1,800 with a Hero5 camera bundled in. **JB**

LEGO BOOST

\$TBC | WWW.LEGO.COM/EN-US/BOOST

Earlier this year, Lego was said to have become the world's most powerful brand, overtaking Ferrari. And now comes Lego Boost, a new 843-brick coding kit that lets create your own working robot. Set to come with a Bluetooth LE-enabled Move Hub that has an integrated tilt sensor, as well as motors and a colour-distance sensor, you'll be able to build five high-tech models — a robot, a playable electric guitar, an interactive cat, a bulldozer and an autobuilder which constructs small models for you. Unlike Lego's more advanced robot-builder, Mindstorms, Boost will utilise the ordinary iconic bricks. The creations can then be brought to life using a simple, easily learned drag-and-drop coding language. Lego is hoping the set will encourage a new generation of robotic enthusiasts and coders.





DELL CANVAS

US\$1,800 | WWW.DELL.COM.AU

Microsoft caused a stir when it launched the Surface Studio last year, but Dell's new Canvas offers similar tech for less than half the price. The Canvas is a touchscreen with a similar sloping drafting table design as the Studio. However, it is only a monitor, so it will work with any existing PC. The Canvas is intended to work as a second screen that can be used for sketching or animation. It even comes with its own version of the puck-like controller that impressed people in the Studio demo. What Microsoft called the Dial, Dell has named the Totem, and both do the same thing: when placed on the screen, it pulls up a circular menu that can be used with different apps, such as a colour picker.

There is a slight trade-off, however, with the Canvas' chunky bezel looking less polished than the Studio and the screen is sub-4K.

PENTAX K-P

\$1,500 (BODY ONLY) | WWW.PENTAX.COM.AU

In digital photography, there are three principles for exposure – aperture, shutter speed and ISO. The ISO rating indicates how sensitive a camera's sensor is to light – the higher the number, the more sensitive, and the better positioned it is to capture images in extreme low light. Most cameras start at a base of ISO 100 or 200, topping out at around ISO 12,800. That's not the case for the Pentax K-P, which is making headlines with its incredible top native speed of ISO 819,200. Higher ISO speeds also mean that you can shoot at faster shutter speeds to get your shot – spectacular news for shooting handheld without a tripod to steady the camera. If you like shooting star trails at night, or other low light photography (such as gigs), then it's the ideal camera. There are downsides, however. Higher ISOs usually equate to more image 'noise' – the grainy dots that take away detail in your images – Pentax claims its new generation sensor combined with a Prime IV imaging engine helps to compensate for that, but you shouldn't expect any miracles.



SOBRO SMART COFFEE TABLE

US\$699 + SHIPPING | SOBRODESIGN.COM



There are many daily necessities that can drag lounge lizards from their perch, but the most common are generally, toilet, bed, to get a drink and work – for many of us, in that order. So we guess it makes perfect sense that there's an Indiegogo crowdfunding campaign for a smart coffee table that doubles as a bar fridge, allowing you to stylishly store enough drinks to never have to leave the couch just because you're thirsty again. Sobro has even more features hidden in its draws, though, with TV-connectable Bluetooth speakers, LED mood lighting and a phone app to complete your living room oasis. We're hoping version two will incorporate some kind of microwave and, fingers crossed, maybe even a chamber pot. **JB**

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit: www.ifixit.com



Relatively simple by design, and easy to fix.

- Disappointingly, tri-point screws

- The heatpipe is secured by Phillips screws, so thermal paste reapplication should be a breeze. We aim for the fan, but it looks like you can only clean it from here — it's trapped under the I/O board. So we pop out the game card reader and attached headphone jack.
- The speakers are lightly adhered to the rear case, but don't put up much of a fight. The larger diaphragms will displace more air, and a ported back allows for booming bass, but reports say they still "favor treble". Phillips screws secure a Joy-Con rail to either end of the console. Each has a set of pin contacts that interlock with contacts on the Joy-Cons to pass

Repairability Score: 8 out of 10 (10 is easiest to repair). Aside from the digitiser, screws are used instead of adhesive. Most components, including the analog sticks, game cartridge reader, and headphone jack, are modular and can be replaced. Batteries, while adhered to their housing, are modular and can also be replaced. The digitiser and display are not fused, reducing the cost of repair, but increasing complexity. Proprietary tri-point screws restrict users from opening the Switch. Replacing a display or digitiser requires heating and prying against strong adhesive. ■

TECHlife AUSTRALIA

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"The NBN as it's being rolled out is a cruel hoax and it sickens me how Malcolm Turnbull can keep saying how great his destruction of the original NBN is."



THE CRUEL HOAX OF THE NBN

The NBN as it's being rolled out is a cruel hoax and it sickens me how Malcolm Turnbull can keep saying how great his destruction of the original NBN is. I'll start off by saying that I am one of the lucky ones to have FTTP. Unfortunately, I am in a minority with the vast majority lumbered with a half-baked MTM mess. Then to make matters worse, NBN Co – at the behest of the government – is furthering the hoax by making promises and then breaking them, all in the name of puffing themselves and the government up.

I have friends and family who are waiting for their half-baked FTTN or HFC service. I have been checking NBN Co's website for progress as that is what the government keeps telling people to do. I do the checking because they are not able to access the site with any reliability on ADSL and ADSL2+. One is in Como (NSW) and is supposed to get the NBN over HFC. Earlier this year, the site said he should get it between March and May 2017. This then shifted to between April and June 2017, and now it has been pushed to July to September 2017. One is in Long Beach (Batemans Bay, NSW). He is supposed to get FTTN, only that has gone from May

2017, to now August 2017. One is in Daylesford (VIC). He is supposed to get FTTN, only that has gone from March 2017, to April 2017, to May 2017, and now it is June 2017. One is in Bendigo (VIC) and that has gone from May 2017 to now July 2017.

All this would have labour requirements and delivery dates. How difficult can giving an accurate completion be? I am a professional engineer, and if I was to deliver a project that had such a 'flexible' timeline, I would never get another contract in any field.

Ian A. White

NBN NOT WORTH HAVING

Our NBN-supplied internet is actually slower – yes, slower – than what we had before via ADSL. We were among the first residents in Redhead, NSW, to get the NBN connected last week, and as very keen early adopters, we are disgusted to report how little the billions of NBN dollars are giving back.

Our ADSL speed was a consistent 24Mbps, but despite optimistically signing up for the fastest 100Mbps NBN service, we're now getting speeds that fluctuate wildly between only 15Mbps and 21Mbps. And that's before the rest of our suburb starts connecting –

which we all know will dramatically slow the speeds further.

Why so slow when the NBN service runs right past our home on its way down the hill?

The explanation is simple. We have amazingly ended up with over 2km of copper! Why so much copper? Because the NBN Co Brains Trust have installed the relevant NBN node nowhere near the area it is servicing... and then they have only used the one pre-existing switch pillar which is located right in the middle of the serviced area.

So what now happens is that a huge distance of copper runs from the stupidly isolated node to the sole switch pillar 1,040 metres away... then from the pillar, more copper runs another 1,050 metres – mostly along the same route back to our house!

We're assuming this isn't actually incompetence, but is deliberate cost-cutting taken to such a level that the finished product is simply not worth having.

Bring back our ADSL service, we say. Or actually build something that truly is 'nation building'. How many billions was it again? What a waste of money!

Paul McLean

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

"Windows 10 S is cheap for laptop-makers to license because it has one big limitation: it'll only let you buy or install apps directly from the Windows Store. You won't be able to download software from anywhere else."



Shut the door on your way in

Is Microsoft's new Windows 10 S the 'walled-garden' Windows that naysayers have long feared? Shaun Prescott weighs in.

There's been no end to the (albeit mild) controversy surrounding Windows 10's Universal Windows Platform and the way, some believe, it will morph into Microsoft's equivalent of the Apple Store — a closed ecosystem without any of the open benefits PC users have enjoyed throughout the years. And so it appears to be with Windows 10 S, a brand new iteration of Microsoft's flagship OS, designed largely for use on entry-level laptops. The OS is effectively the tech giant's latest attempt to grab some of the low-budget Chromebook and education markets, but it's also a clear demonstration of Microsoft's movement towards selling services and subscriptions.

Windows 10 S is cheap for laptop-makers to license because it has one big limitation: it'll only let you buy or install apps directly from the Windows Store. You won't be able to download software — neither games nor applications — from anywhere else. This is great for Microsoft because it funnels users into

a marketplace where they get a cut from every sale, but it reduces much of the freedom and flexibility PC users have come to expect. In Microsoft's words, it's a system that's "streamlined for security and performance" but we'd argue there are other ways to do that.

This blocking of the free installation of software — not to mention the ability to do with your PC as you wish — is what has caused the ruffling of feathers. Sure, there's no one forcing you at gunpoint to buy a Windows 10 S device, but it seems ominous, because this walled-garden approach to an OS is exactly what critics of Microsoft's Universal Windows Platform feared in the first place. Want to use the free, open-source OpenOffice for word processing? Too bad — you'll need a subscription to Office 365 instead. Want to play *Minecraft*? Well, I hope you're prepared to play with the Microsoft Store's watered-down, unmoddable version of it.

There's also the sticking point of what's available on the Windows Store.

Microsoft's previous attempt at a closed-platform, low-cost OS, Windows RT, suffered immensely from this, as it was tied to the dire app scene that Windows phones and the earlier Surfaces were renowned for. And while the Microsoft Store is better populated now, it's still got a long way to go until it can rival the Apple and Android libraries. If Windows 10 S, and by extension machines like the Surface Laptop, prove successful, no doubt the Windows Store marketplace will grow at an even quicker rate.

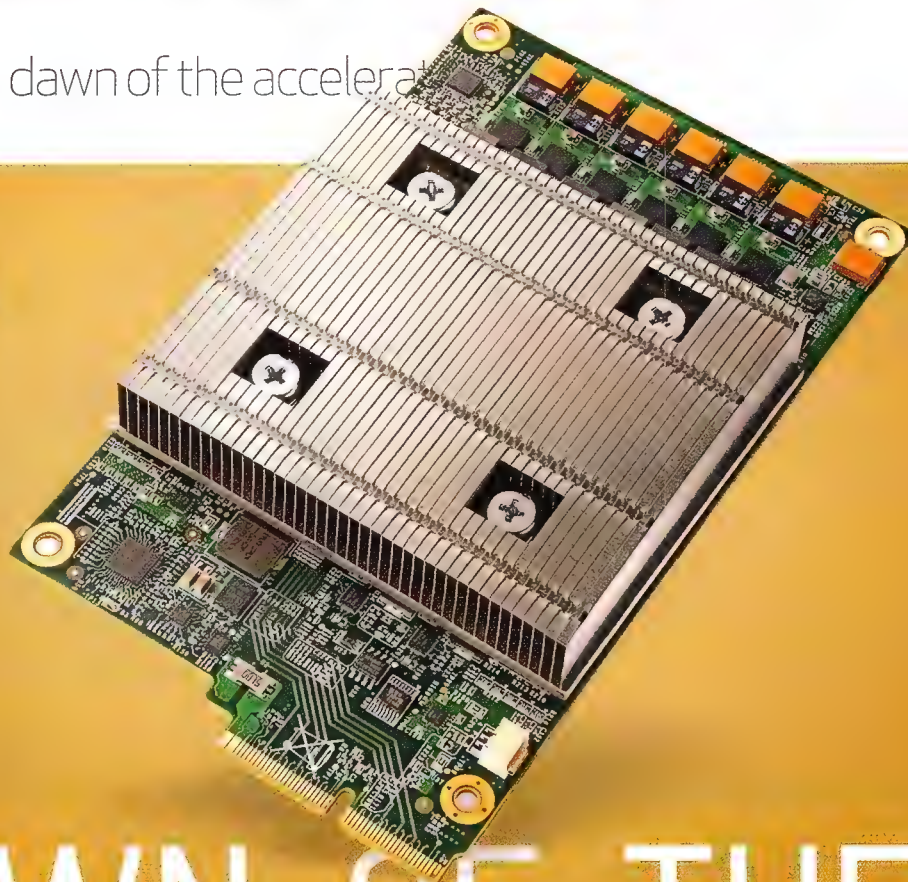
And yet, it could be argued that the reason people choose Windows over Mac laptops is because of the perceived freedom. But can anyone who's used both say, objectively, that Windows is still a more open and 'freer' OS than its Mac counterpart? Many will even answer that Apple has an advantage here. Whatever the case, Microsoft has a lot to prove with Windows 10 S, and device buyers should carefully consider the limitations before pulling the trigger on a 10 S laptop. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Google's 'tensor programming unit' is aimed at accelerating machine learning.



DAWN OF THE ACCELERATORS

THEY'VE POWERED COMPUTERS SINCE THE MID-1970s, BUT IS THE REIGN OF THE CPU COMING TO AN END? DARREN YATES INVESTIGATES THE 'POST-CPU' TECHNOLOGY CHANGING HOW WE COMPUTE.

Ever thought about the range of computing devices in your home? It could be the odd desktop PC, a couple of laptops, a games console or two, smartphones, tablets, media players, set-top boxes, smart TVs... the list goes on. What makes these devices possible is the vast array of central processing units (CPUs) now available, chips designed to run an operating system and mountains of software code.

But as the sliding fortunes of the PC collide with rapidly growing demand for faster artificial intelligence/machine learning, plus the threat of high-tech 'quantum computers' waiting tantalisingly on the horizon, there's an alternative computing technology that major tech companies are taking seriously. It's appearing in everything from retro-gaming consoles to high-

demand applications, such as search and machine-learning, and in one particular form, comes with a feature that CPUs can't match – the ability to create your own chips.

ALPHABET SOUP

Our modern lives are filled with digital technology, virtually all of it run by small chips or 'integrated circuits' that perform all manner of functions, from starting your car to powering your toothbrush. Those chips can be broadly grouped into three categories that read like an alphabet soup.

Application-specific integrated circuits (ASICs) are chips that usually just have one job – it can be almost anything, but each chip does just that one thing. It means they're exceptionally fast at what they do because the required function is hard-coded into the chip's electronic switches or 'transistors'. This single-

function operation also makes them very power-efficient because only the transistors required for the job are included, ideal for when you're using ASICs by the thousands in large installations or on their own in battery-powered devices. But the drawback of ASICs is that, once you've made the chip, it can't do anything else. Need another function? You need another chip.

At the other end of the scale are the traditional microprocessor chips – the CPUs that power your phone, PC, tablet, games console and seemingly everything else. Intel made the first CPU chip, the 4004, back in 1971. Since then, CPUs have broadly consisted of separate fixed-function blocks, programmable through the software you load to join those blocks together into everything from spreadsheets to games. But CPUs also have drawbacks: because they're programmable via software, CPUs are usually much less



RetroUSB's AVS powers NES games cartridges using an FPGA chip.

"Our modern lives are filled with digital technology, virtually all of it run by small chips or 'integrated circuits' that perform all manner of functions."

power-efficient than ASICs, thanks to the many, many more transistors required for this greater versatility and flexibility.

The added complexity of modern CPUs means it's also difficult to get more of them running together in parallel. When Intel and AMD struck trouble trying to run their CPUs faster than 3.6GHz during the mid-2000s, they began adding multiple CPUs into the one chip – that's where dual-core and quad-core chips came into play. The idea was that if you couldn't run a single CPU faster, you could at least get more speed by running multiple CPUs together. But even today, it's rare to see more than eight CPU cores inside consumer devices.

Straddling these two extremes is a different computing technology called Field-Programmable Gate Arrays (FPGAs). They're computing chips you can program, but unlike CPUs where your function code or 'algorithm' runs as software, FPGAs turn your algorithm into hardware. They've been aptly described as a bucket of Lego bricks you can wire together in almost any form your application requires. But while they've been around in one form or another since the mid-1980s, FPGAs have attracted renewed corporate attention in recent times as traditional CPUs struggle with the global migration to cloud computing.

MAKING YOUR OWN CHIP

Creating your own chip using FPGA technology is a little bit like making your own gadgets using the popular Arduino microcontroller boards.

You code the function you want your chip to perform, then that code is used to program the chip. The major difference is that, instead of just compiling your code and storing it in the chip's on-board flash storage as Arduino does, FPGA programming involves actually rearranging an FPGA's internal connections. In other words, you're creating your own hardware. FPGAs are also reprogrammable – you can reprogram an FPGA and completely change its function. It's the chip-equivalent of starting with an iPhone 7 smartphone, updating the code and now having a Galaxy S7.

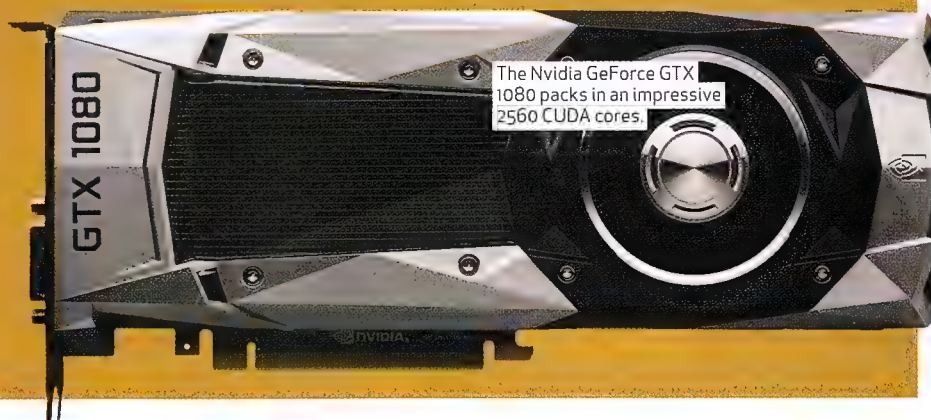
The code to program an FPGA is similar to the C programming language and known as a 'hardware description language' (HDL). These languages, such as VHDL and Verilog, turn a circuit function schematic into a series of commands that rearrange the FPGA's internal connections to form the required functions. The FPGA chips themselves are not expensive – the DEO-Nano is a US\$99 development board featuring an Altera Cyclone 4

FPGA chip with over 22,000 logic function blocks or 'elements'. And because these logic blocks are, in many cases, similar to those that make up traditional CPUs, you can even turn an FPGA chip into your own custom CPU chip.

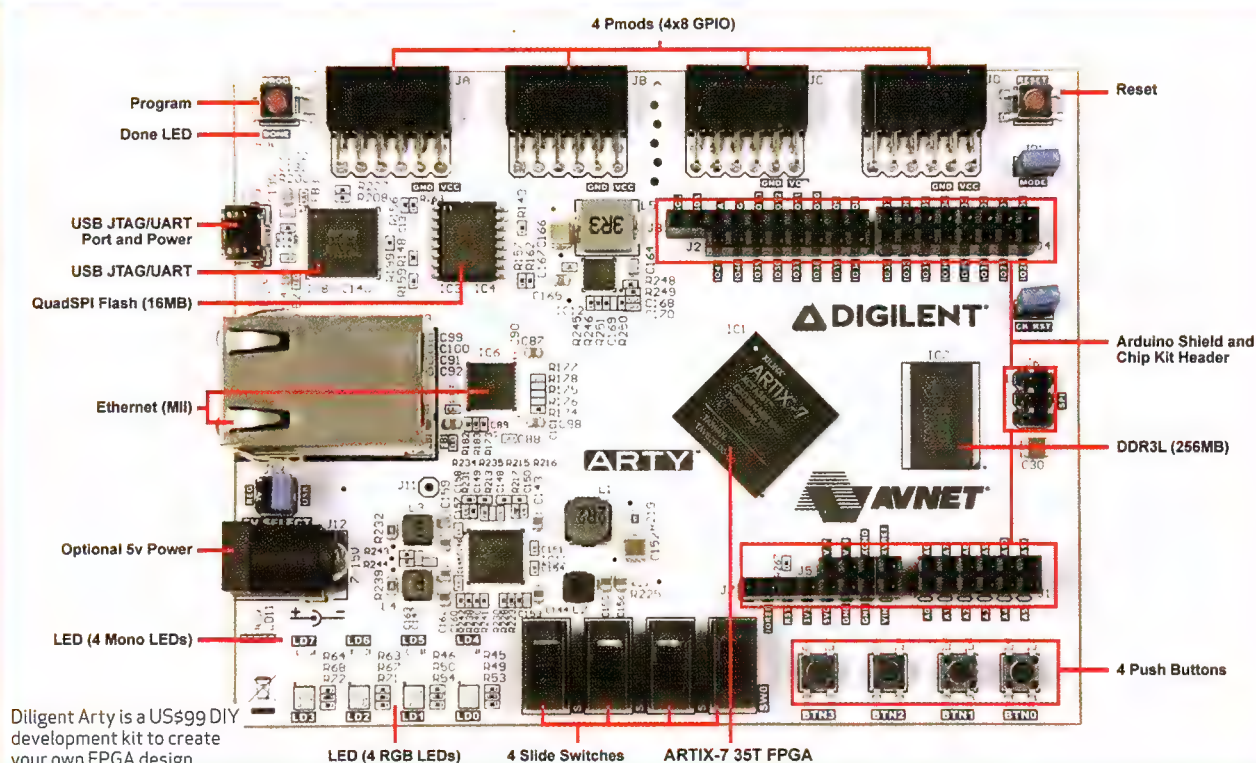
FPGA AND GAMING

Some of that might sound like gobbledygook, but here's where the electrons hit the silicon – one surprise application for FPGAs gaining momentum is retro-gaming. While many gamers scratch their occasional retro-gaming itch with an emulator or a NES Classic Mini (if you've managed to find one, or perhaps made your own from our how-to in issue 437, page 96), there's a group for whom nothing short of genuine hardware and perfect compatibility is sufficient. These gamers go for genuine consoles or failing that, luxury rebuilds using genuine original tech.

Long before Nintendo launched the NES Classic Mini, researchers



The Nvidia GeForce GTX 1080 packs in an impressive 2560 CUDA cores.



had found FPGAs could replicate original NES console hardware and the concept has since gone commercial. The retroUSB AVS is a NES-class console that runs NES cartridges better than the original NES console itself. It outputs 720p video through an HDMI output,

but there's no actual Nintendo hardware on-board — it's all powered by an FPGA chip.

And it isn't alone — Analogue created 2016's well-received Analogue NT NES console, reportedly built using remaining stocks of genuine Famicom (Nintendo) hardware made over 30

years ago. However, Analogue recently announced a new smaller and cheaper NT Mini which claims to maintain full compatibility with NES/Famicom cartridges, but no longer relies on 'new old-stock' hardware. Again, it uses an FPGA chip to mimic the features of the original Nintendo hardware, but goes further to support extras like 1080p output over HDMI.

The NES Classic Mini might give you 30 games for \$99, but the US\$449 NT Mini's compatibility reportedly ensures it can handle over 2,000 NES-compatible game cartridges. More importantly, it shows that FPGAs not only can replicate retired hardware, they're sufficiently advanced to create custom CPUs.

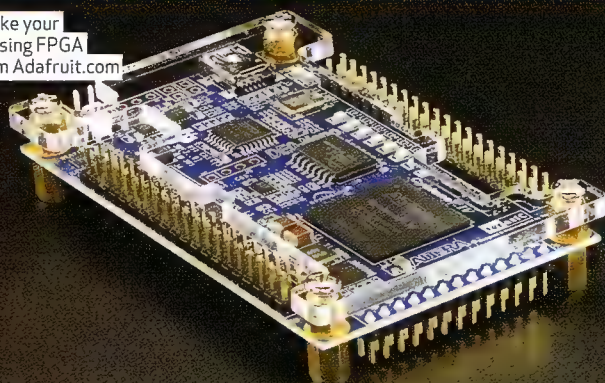
THE ACCELERATED BOOM

However, the spotlight shining on FPGA tech over the last few years is less about retro-gaming and more about the boom in machine learning, AI and the ever-growing need for speed.

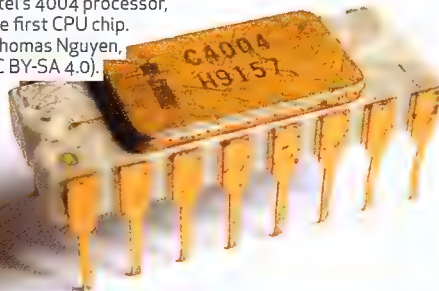
FPGAs and ASICs are often called 'accelerators'. While FPGAs can be made to emulate genuine CPUs for gaming consoles, they're also known for their ability to work in parallel, plus their very low delay or 'latency' times.

One application where latencies have become critical is financial markets. Share trading took a major leap into the future in 1971 when the US NASDAQ became the first computer-traded share market. These days, computers aren't just making trades, they're deciding what,

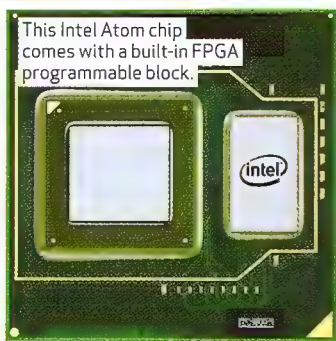
You can make your hardware using FPGA boards from Adafruit.com



Intel's 4004 processor, the first CPU chip. (Thomas Nguyen, CC BY-SA 4.0).



This Intel Atom chip comes with a built-in FPGA programmable block.



when and how much to trade in what's known as 'high-frequency trading' (HFT). A key requirement of HFT is speed — using machine learning to understand market data in real time to make high-speed buy/sell transactions.

PROJECT CATAPULT

That latency and parallelism capability has also seen another major market player show serious interest in FPGA. Back in 2011, Microsoft launched Project Catapult, a research project to look at post-CPU technologies for cloud computing, which included FPGAs, ASICs and graphics processing units.

We use GPUs at home to play games on PCs, consoles and phones, but they're increasingly being used in business applications for their speed and parallelism. For example, Nvidia's brand-new GeForce GTX 1080 Ti graphics card boasts 3,584 processing cores designed to crunch data for high-resolution gaming at incredible speeds. But through Nvidia's CUDA application programming interface (API) code, software developers can tap those GPUs for everything from mining Bitcoins to calculating climate models (GPUs have also been known to crack passwords).

However, Microsoft ended up settling on FPGA technology and has created what it calls an 'AI supercomputer', linking its worldwide data centres, with FPGA chips. That tech now powers Bing searches and Microsoft's Azure cloud computing services.

TENSOR PROCESSING UNITS

Meanwhile, Google might be better known for its Android operating system, but it, too, is dabbling in accelerator chips, creating a custom and still-mostly-secret 'tensor processing unit' (TPU). A 'tensor' is a mathematical object that can be described by 'arrays' or groups of numbers. A row or column of a spreadsheet can be a one-dimensional array representing a first-order tensor, a single-page spreadsheet with rows and columns can represent a two-dimensional array or second-order tensor. Google isn't handing out too much information about how its TPU works just yet, other than it being an ASIC rather than FPGA design. That said, it has revealed that the custom ASIC delivers roughly a ten-times or 'order of magnitude' improvement in machine-learning performance per watt compared with traditional options, which is a massive gain.

THE CPU MARKET IS CHANGING

But this growing market demand for accelerator chips is the sort of thing you'd expect to make CPU makers nervous. More accelerator chips will

likely mean buying less CPUs, so if you're a CPU maker in this situation, you start thinking about combining the two. Chip manufacturers have been dabbling in mixing CPUs with FPGAs into a single chip since at least 2010 — that year, Intel embedded an Altera FPGA core into an Atom E600C chip, while FPGA maker Xilinx put a CPU from phone chip designer ARM into its FPGAs chips.

But with the FPGA market heating up, Intel decided to put down a hefty US\$16.7 billion at the end of 2015 and buy FPGA maker Altera. And it didn't muck around — a few months later, it revealed a Broadwell-class Xeon server processor with Altera's Arria 10 FPGA in the same chip package.

THE FUTURE OF THE CPU

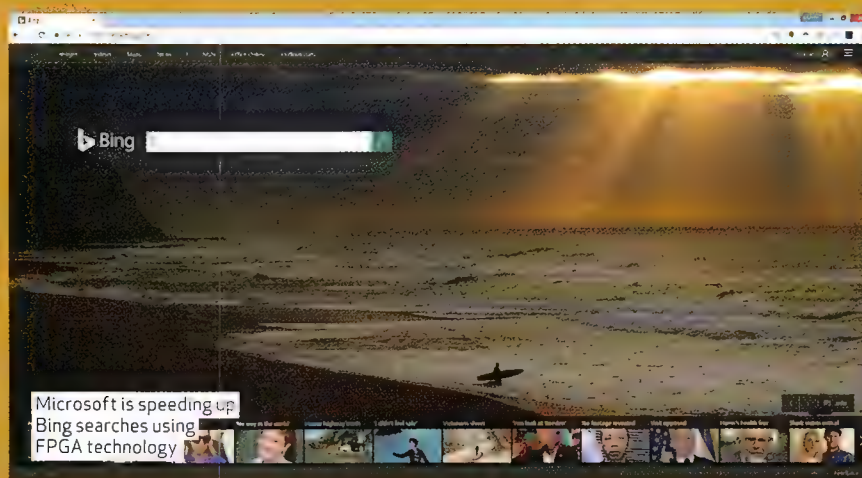
As cool as FPGA-powered consoles are, you don't spend nearly US\$17 billion to make chips for retro-gaming. The real goal is machine learning and data centres. It's a commonly held belief that we're producing data at an exponential rate — according to IBM, 90% of the world's data was generated in just the last two years, data that's stored in data warehouses and increasingly needs machine learning to search and

manage. Google says its squadron of TPUs can find every piece of text in its global Street View database in under five days and just one TPU can process over 100 million photos each day in Google Photos. Meanwhile, Microsoft says its ability to write algorithms direct to its FPGA network can save two years waiting for hardware upgrades. Now, the hardware can be upgraded in code.

The rise of the accelerators will inevitably lead to the question of whether or not the end is in sight for the CPU. As more of our data — and data processing — ends up in the cloud powered by all manner of ASICs and FPGAs, there will likely be a corresponding drop in the needs for CPUs based on current tech.

With research into quantum computing engines that promise processing on a revolutionary scale, some might believe current CPU tech is riding its last great wave. But the reality is that traditional CPUs will still be around for a long time to come, at least until something else comes along that can match them on a price-performance scale.

Now, though, where's that NES console gone...? ■





CPU

\$359 | WWW.AMD.COM

AMD Ryzen 5 1600X

Taking AMD's new hexa-core hotness for a spin.

When AMD pulled the wraps off its radical new Ryzen CPU, it was all about those eight awesome cores. Count 'em, Intel. The first Ryzen 7 chips blew the market for \$600-plus CPUs wide open. But not everybody can unload that kind of money on a processor, especially a brand new design that also requires a motherboard upgrade. Enter the Ryzen 5 1600X. On paper, it might just be the ultimate balancing act between performance bang and efficient deployment of your hard-earned buck.

The 1600X packs six cores and supports 12 threads, while a similarly priced Intel processor, the Core i5-7600K, has four cores and just four threads. And as a consequence of being the top six-core model, it also clocks in at 3.6GHz nominal and 4.0GHz turbo. It looks like a very nicely balanced chip. And for \$359, it's the mid-range CPU that we've all been waiting for, right?

For the most part, yes. When it comes to outright multithreaded performance, it pops a cap in the head of the Intel Core i5. The Core i5-7600K manages 663 in Cinebench. The Ryzen 1600X? A massive 1,223 points, nearly double the Core i5's capability.

Admittedly, the Core i5 retains some dignity in the single-threaded version of Cinebench, with 179 points compared to the 1600X's 159 points. However, the AMD chip looks like the better trade-off at first glance. Elsewhere, if the results aren't quite so spectacular, AMD still chalks up some decent wins. It crunches high-quality video encoding at 22fps to the i5's 16fps, and it motors through the Fry Render benchmark in just 3 minutes and 46 seconds — two minutes faster than the 7600K.

If you want a CPU for content creation or any workload that majors on parallelism, this isn't a race. The Intel competition is hideously, hopelessly

outclassed. That's true even taking into account the fact that the Ryzen CPU is a little more power-hungry. An extra 10 watts at the wall is surely worth it.

Where the Ryzen is a little less compelling is in the games arena. When it comes to average frame rates, the 1600X delivers on that 4GHz promise. The subjective experience, however, tells a slightly different story. *Total War: Attila* is a great case study. Running on the Intel processor, it's super-smooth, whether you're up in the sky, lording it over your troops, or down in the thick of the action. But with the Ryzen CPU at the same settings and using the same video card, there's juddering almost everywhere.

There are a few reasons why. We used an Nvidia GPU, and there are at least indications that the Nvidia driver is poorly optimised for Ryzens. There are also question marks surrounding Ryzen's basic architecture, which is composed of a pair of quad-core modules.

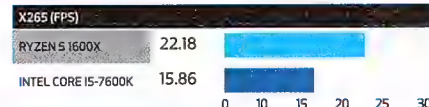
Some latency is involved in communicating between the two quad-core modules, and that can require careful management by both OS and application to avoid performance penalties. Ryzen is brand new, so most software has yet to be tweaked to take account of such issues. Of course, most software runs OK without any modifications.

On a final note, like other Ryzen processors, the 1600X has pretty much zero overclocking headroom. AMD has these things running pretty ragged. An additional 100MHz was the best we could achieve.

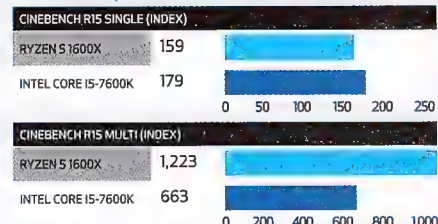
■ Jeremy Laird

LABS BENCHMARK RESULTS

General performance



Multimedia performance



Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

The six-core design makes this an appealing choice in some circumstances, but this is not for gamers (yet).





GRAPHICS CARD

\$420 | WWW.SAPPHIRETECH.COM

Sapphire Radeon RX 580 Nitro+

Revamped, reclocked, rebadged.

Oh AMD... Why do you do this to us? You fight, you riot and you revolutionise the processor industry, then tease us with a brand new graphics card, only for it to be little more than a rebadge. Let's cut straight to it, there's very little new about the Radeon RX 580. The launch of this new GPU came with little fanfare, and with good reason.

Moving from the RX 480 to the 580 provides nothing more than a slight overclock to the base card. Indeed, you could achieve the same results, by bumping up the power target to 110% and moving that clock frequency slightly higher. So why do it? Good question. We can only guess that it's down to improvements in the manufacturing process. Rumours abound, we know that Global Foundries (the guys who manufacture AMD's GPUs and CPUs), use Samsung's 14nm LPE

technology in its 400 series cards. It's possible that with the RX 500 series, GloFo is using Samsung's (newly announced) 14nm LPU tech instead, improving power efficiency and clock speeds in the process. Which may explain the additional 30W TDP included and the slightly higher clocks.

That aside, it's the nomenclature that gets us. Traditionally with every new series of cards, you'll get one or two rebadges. For instance, a 380 becomes a 470, a 370 becomes a 460 and so on. Dropping the price point, and improving power efficiency in the process is great for the consumer. The 580, on the other hand, has missed that beat. The RX 480, has migrated across to the 580. This would make sense if AMD was about to embark upon a new naming scheme, or even if it were to launch two new flagships with these rebadges, but that's

not the case. So why do it? If anything, these two cards should've been renamed the 485 and the 475.

How's it looking from a performance perspective? Well, we have to make clear that our RX 580 sample was the Sapphire Nitro+ pre overclocked, compared to our stock RX 480. In game, we saw an increase of around 10% across our titles at 1080p. Going from 61fps in *Far Cry Primal* to 66, 58 to 67 in *The Division*, and 34 to 40 in *Rise of the Tomb Raider*. Fairly impressive for a GPU that is essentially just a refresh.

This card is aimed at those who still haven't upgraded from AMD's R9 300 series, or the lower end of Nvidia's GTX 900 series. It's a refresh on an already well priced, well manufactured graphics architecture, bringing that price to performance heritage forward into 2017. It's actually in a bit of a sweet spot. It doesn't quite

wipe Nvidia's GTX 1060 3GB off the top of the 1080p hill, but it's close. Couple it with a decent FreeSync 1080p monitor and you'll be onto a winner.

There's been no official announcement from AMD yet as to when Vega may launch, although rumours speculate that it could be any time within the next few months. By the time you read this, it may well have been officially announced at Computex. Until then, you might want to hold off on those big GPU splurges.

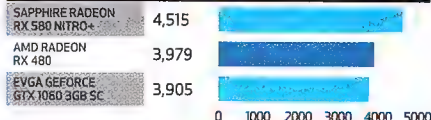
■ Zak Storey

LABS BENCHMARK RESULTS

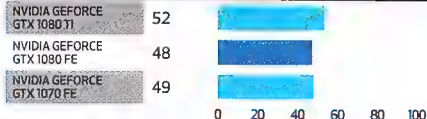
3DMARK: FIRE STRIKE (INDEX)



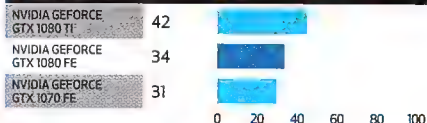
3DMARK: TIMESPY DX12



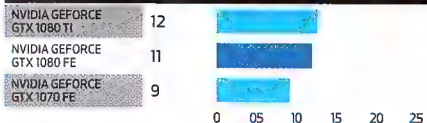
FAR CRY PRIMAL (FPS)



THE DIVISION (FPS)



RISE OF THE TOMB RAIDER (FPS)



Verdict

Features
Performance
Value



Solid performance at 1080p, impressive value for cash, quiet and cool, but can be achieved on an RX 480 with OC.

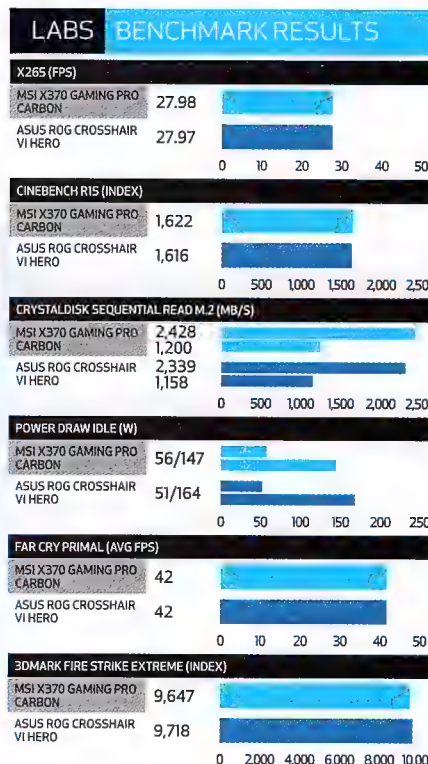


THE
MOST FUN
YOU CAN
HAVE WITH
YOUR HANDS
WITHOUT
GOING



AMD MOTHERBOARD

\$289 | AU.MSI.COM



MSI X370 Gaming Pro Carbon

Carbon fiber all the things.

Gigabyte's Gaming 5 series has generally always been the value king, but it might need to rethink its game plan with the likes of MSI dropping this sweet little number on to the AMD playing field. It may not have as clean a look as Gigabyte's mighty Aorus lineup, but it's hard to deny that the connectivity is there.

Well, OK, so you lose out on a few banks of SATA 3, there's no U.2 and it's still prone to MSI's haphazard butchery of the rear I/O, but all in all, it's a well specced board for anyone looking to build a fairly entry-level Ryzen rig, even featuring DVI-I for those future APUs that might come out soon (seriously, we don't know). All joking aside, couple this with a Ryzen 5 1600, and you're looking at a potential six-core, 12-thread, DDR4-touting overclockable workstation base.

So aesthetics. Yeah, it's covered in a carbon fibre finish. We're not sure why.

Honestly, do motherboards benefit from being lighter? It's a chequered finish that you'll either love or hate, and it's certainly different. Let's call it that. OK, MSI, truthfully: We don't like this finish. Keep it black, have a brushed aluminium styling on it, clean it up, keep the lines straight and the MSI logo sharp, and you'd be on to a classic.

On the other hand, the black finish across the board is neat, and the RGB lighting is easy to configure to any colour you want in MSI's desktop app.

Onboard audio across the brands right now is pretty solid. Not quite up to the level of DAC and HRA, but for anyone simply wanting to plug and play, you're unlikely to find much difference between models. The Nahimic audio suite included with MSI's lineup since the Z170 series, on the other hand, is a force to be reckoned with. For those familiar with THX's Crystalizer software, way back in the days of Windows

7, think of this as that on steroids.

On to performance, and the Gaming Pro Carbon actually outshone its XPower cousin in the X265 benchmark, Cinebench, and even Fry Render, by around 1% in most cases. Memory latency was fairly middle ground, with power draw being our overall winner, both under load and idling. We also managed a swift 3,000MT/s overclock on our 16GB Corsair Vengeance LPX kit, as well — with the latest BIOS update, of course. We can't stress enough how important it is that you update your BIOS if you're already using — or thinking about jumping on to — the AM4 platform.

The Gaming Pro Carbon is a real show-topper. Coming in at \$80 less than the Crosshair VI Hero, and packing that vital core performance, its stability, memory support and overall feature set are more than enough for anyone looking to sate their eight-core desires.

At only \$289, with that extra bit of cash in your pocket, you could upgrade from a six-core Ryzen 5 1600X to an eight-core Ryzen 7 1700. Whack that clock speed up to 4GHz, and you'd easily be rolling above the 1800X, and within spitting distance of Intel's Core i7-6950X.

Ultimately, MSI's X370 Gaming Pro Carbon is one of the best value boards out there. If you're looking for all the connectivity and features that Ryzen has to offer in an affordable package, and aren't too bothered about aesthetics, the Pro Carbon is definitely the board for you.

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Dependable feature set but with a questionable appearance, it luckily has solid performance at a staggering price.





LAPTOP

\$1,399 | WWW.ASUS.COM/AU

ASUS ZenBook UX430UQ

It may seem like the runt of the ZenBook 3 litter, but a laptop this special doesn't come around too often.

If you were to judge it based on its price, you'd probably guess that ASUS's UX430UQ is just a slightly-less-sleek, mid-range sibling to the ZenBook 3 – but to reduce it to that would be a huge injustice.

From the outside, it's not difficult to tell that the 15.9mm-thick UX430UQ is a different range of device to the 12mm-thick ZenBook 3 laptops. The UX430UQ does still share the premium-looking concentric brushed-metal finish of its pricier sibling, and the compact bezels that trim the vibrant 14-inch 1080p screen make it clear that this is a carefully crafted machine.

The UX430UQ isn't fitted with the fastest components money can buy. The 2.5–3.1GHz Intel Core i5-7200U CPU costs half as much as the 2.7–3.5GHz i7-7500U CPUs powering today's top-tier ultrabooks, for example. Yet, this cheaper CPU is not only amply powered, but often provides

near-identical performance across general computing tasks. The UX430UQ kept up with and then outpaced the more-expensive ASUS ZenBook 3 (see APC 435, page 22) and its i7-7500U CPU in PCMark 8's Work and Home benchmarks with the former picking up scores of 4,401 and 3,474, compared to the latter's 4,556 and 3,049. It wasn't just ASUS's more expensive laptop that the UX430UQ usurped, it also pipped Venom's BlackBook 14, the early 2017 Razer Blade Stealth and Toshiba's Portégé X20W-D (see issue 441, page 27 for the full review) in PCMark's Home and Work. In addition to being more expensive, the last two units mentioned here have technically better CPUs and 16GB of RAM – twice as much as the UX430UQ. When you compare the raw processing power of each core of the UX430UQ's CPU against laptops with Intel's Core i7-7500U and i7-7600U, you'll see that the latter two

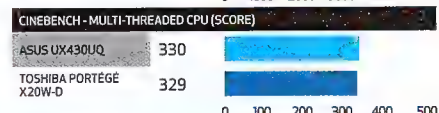
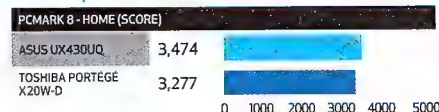
score higher, but when these core outputs are combined – for example, in Cinebench R15's multi-threaded benchmark, all three of these CPUs perform almost identically. That's likely a side-effect of the Toshiba and Razer's thinner chassis, too, where heat can't be as efficiently dissipated, meaning the CPUs don't as often reach those upper boosted GHz speeds.

The UX430UQ also gets a performance boost thanks to its dedicated GPU. The Nvidia GeForce 940MX isn't exactly a top-shelf GPU, but it does add modest gaming capabilities to this unique ultrabook, comparatively supercharging it for any professionals that dabble in GPU-heavy tasks. While it's true that to play any modern titles above 30fps, you will need to dial down the resolution to 720p and set graphics to Low, we haven't seen anything like this in an ultrabook since Microsoft's similarly specced \$3,000 Surface Book.

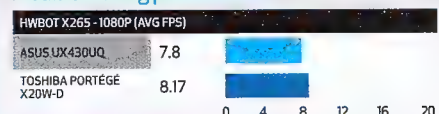
It would have been nice to get a bigger and faster SSD (say, a 512GB PCIe model rather than the 256GB SATA 6Gbps), but when the more expensive competition don't even really offer this, it's hardly a fault. There's also always a tradeoff between power and battery life, and scraping in at 3 hours and 24 minutes on PCMark 8's battery benchmark means it's a bit behind the best in the category, and will struggle to make a full day's usage. Other than that however, there's little to complain about. It's an exceptionally well-balanced ultrabook. ■ Joel Burgess

LABS BENCHMARK RESULTS

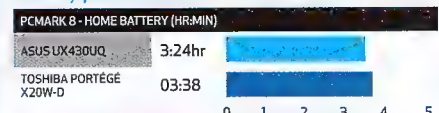
General performance



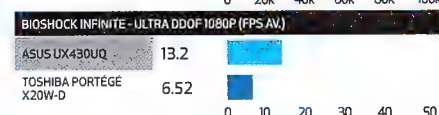
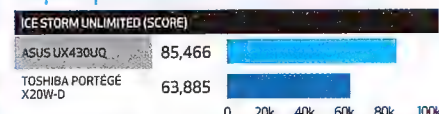
Media encoding performance



Battery performance



Graphics performance



Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

This powerful and portable ultrabook cleverly trades off a little battery life for a significant GPU power boost.





GAMING LAPTOP

\$3,099 | AU.MSI.COM

MSI GT62VR 7RE Dominator Pro

Is MSI's real-world Gran Turismo gaming laptop as fast as it sounds?

The GT62VR 7RE Dominator Pro is the dictionary definition of a gaming laptop – powerful, pricy and as aesthetically appealing as the wrong end of a server room.

Blanketed by MSI's trademark brushed metal veneer on the lid and keyboard surround, the GT62 chassis switches to lighter, cheaper structural plastic everywhere else – which helps reduce the weight of this heavy unit.

Attached to the top of that girthy 4cm-thick body is a responsive and well spaced-out SteelSeries membrane keyboard and a reasonably pleasant-feeling trackpad equipped with no-nonsense bucktooth left and right click buttons. While the three USB 3.0 ports, SD card reader, single USB 2.0 and multiple audio outputs line the edges of the unit, the four-pin 19V/11.8A DC power input, Ethernet

connection and video outputs (HDMI, USB 3.1 and DisplayPort) have been relegated to the back.

Prioritising power over portability, this 3kg beast packs in some serious components with the latest seventh-gen Intel Core i7-7700HQ CPU, an Nvidia GeForce GTX 1070 GPU and enough fans to keep this power hungry setup at a comfortable temperature. The only other laptop we've tested with that GPU is Gigabyte's P57x V6, which pushes a near identical set of components, but based on Intel's sixth-gen tech. With 16GB of DDR4 RAM, MSI's GT62VR 7RE actually outpaced the V6's PCMark 8 Home and Work scores of 4,007 and 4,930, with lofty results of 5,017 and 5,384 in these general-performance tests. These scores are more than the 10% boost you'd expect when comparing against the P57x V6's sixth-gen CPU.

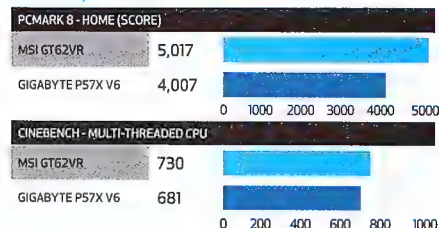
Also neat is that the 1080p IPS display offers G-Sync, although only at a refresh rate of up to 60Hz – that means you can get buttery-smooth visuals, but they won't come with the super-responsive feel that high refresh-rate 120Hz/144Hz desktop monitors can give. What's a little disappointing is that, despite those near top-shelf components, this laptop didn't perform quite as well in gaming as we'd hoped. In *The Division* and *Tomb Raider* benchmarks on 1080p Ultra settings, the GT62VR got averages of 66.5 and 262.7fps, surpassing the P57x V6's results of 60.1 and 213.9. However, we saw some wobbly results in both *Far Cry Primal* and the intensive *Metro: Last Light*, where the MSI was anywhere from 15 to 50% slower in some tests. Despite troubleshooting the issue, we were still trying to get to the bottom of it with MSI at the time we went to print.

Moreover, with a meagre 1 hour, 20 minute battery lifespan in PCMark 8's Conventional Work battery life test and acceptable max CPU and GPU temperatures of 91°C and 81°C under load, there are more than a few niggling elements in the GT62VR 7RE.

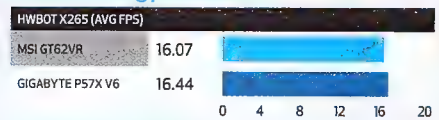
Unfortunately, this laptop has more than its fair share of sacrifices and though the G-Sync panel is a nice perk, it's an expensive one. For us, it's not quite enough to justify the \$300 you'll pay for this unit over its P57x V6 competition. **Joel Burgess**

LABS BENCHMARK RESULTS

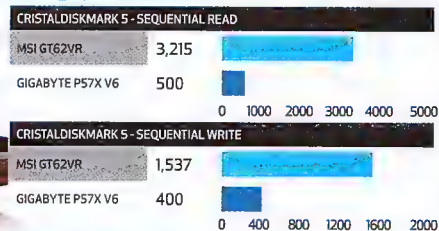
General performance



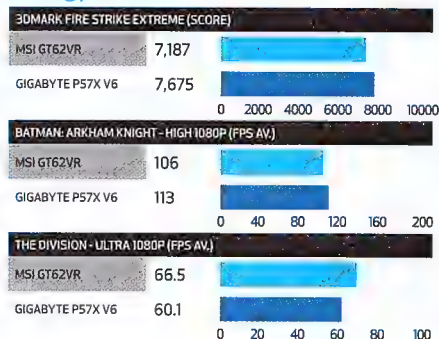
Media encoding performance



Storage performance



Gaming performance



Verdict

Features
Performance
Value



A powerful performance-first gaming laptop that would benefit from more gaming optimisation and a price cut.





The home of technology

techradar.com



PC

\$3,149 | WWW.CORSAIR.COM

Corsair One Pro

System integrator Corsair. Wait... what?

Corsair has long been a trusted brand in the PC building world, known for its quality and high-end components and peripherals. But until recently, the company hadn't jumped into the arena of complete, pre-built systems.

With the One, Corsair is looking to change all that. It's a triumph of excellent performance, clean design and small-form-factor engineering. Measuring 20 x 17.6 x 38cm, the One stands only a little taller than a Mac Pro.

Both the CPU and GPU are cooled by their own individual 240mm radiator. But rather than outfitting each of those with their own fans, the entire system is cooled by a single 140mm maglev fan up top that through convection, draws cold air in through the radiators and exhausts it out the top. The result is a well-cooled system with a minimal footprint that runs whisper quiet.

The overall design is impressively compact. There's no doubt that you could build and even buy Mini-ITX systems that are smaller than this beast, but there's no wasted space here and no add-ons just for the sake of having frills. The One takes the best that Corsair has to offer and distills things down into a very svelte machine. Did we mention it's powerful?

Packed inside is an Intel Core i7 processor, an Nvidia 10-series GPU, as well as plenty of storage, varying by tier – the One starts at \$2,499 for an i7-7700, GTX 1070, 240GB SSD and 1TB HDD, and goes up from there. The 'Pro' unit we tested featured an i7-7700K, GTX 1080 and 960GB SSD, for a retail price of \$3,149.

The One punches out some serious performance, too, hot on the heels of much larger, beefier systems. Gaming performance fell short of setups with dual-GPU loadouts, but the One's single GTX 1080 beat almost all of the other single-card

systems we've tested in the last year.

The Corsair One more than delivers on the promise of excellent gaming in a small package. Even better, it does so without relying on large, loud fans. For most small form factor systems, heat management is often their Achilles' heel. Not so with the One: performance remained stable even after running our high-load benchmarks.

Pre-built systems are well known for adding a small price premium over the cost of building the rig yourself. However, if you add together the individual cost of everything packed inside the One, you reach a price not massively cheaper than the cost of the complete system, especially when you add in Windows and building time. Either way, Corsair brings decent value to the table here.

Small form factor systems are especially tough to build inside, and the innards of the One are manicured with precision. Similarly, the

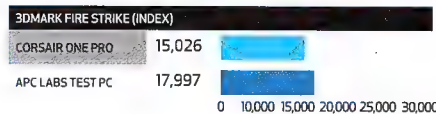
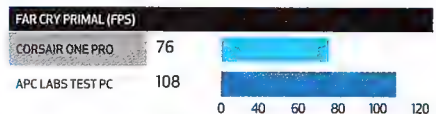
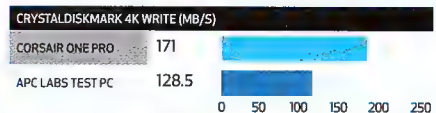
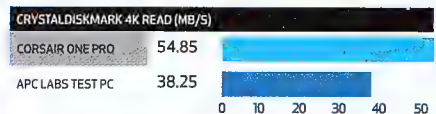
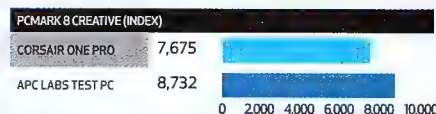
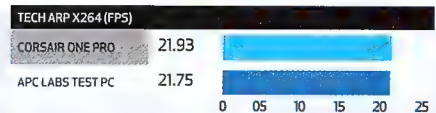
One's custom chassis isn't the kind of thing you can easily recreate yourself. There's also the added benefit of a manufacturer's warranty – two years of parts and labor covered. But the ease of having a plug-and-play gaming system that looks great and performs even better is priceless for some.

The One is nothing short of a major milestone for Corsair. Having made components and accessories for decades, the company is now in a position to fuse all of its strengths together into one beautifully designed tower of power.

Bo Moore

LABS BENCHMARK RESULTS

Multimedia performance



Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Excellent gaming performance with a small, sleek design. Difficult to access the interior but that's to be expected.



"The screen is 9.7 inches, with a resolution of 2,048 x 1,536. There's nothing fancy about it — you don't get the TrueTone display or wide colour gamut of the iPad Pro. It's just a beautiful, detailed, bright screen that we have no complaints about for the cost."



TABLET

FROM \$469 | APPLE.COM/AU

Apple iPad (2017)

Subtle tweaks and lower pricing make this the best-value iPad yet.

This iPad is the most exciting boring update to a product we've ever seen.

It's the replacement for the iPad Air 2 at the lower-price end of Apple's 10-inch tablet range, and doesn't include any fancy new tricks or features. What it does is take a great tablet, make it a little bit faster, a little bit cheaper and give it even better battery life.

These upgrades come with a surprising downside — it's thicker and heavier than the iPad Air 2. It's pretty weird to see Apple add bulk to a product given its near fetish-level obsession with all things thin and light, but this iPad is the same 469g weight and 7.5mm thickness of the original iPad Air. That's a weight increase of just 32g and a more noticeable 1.4mm thickness.

So that's the one really obvious downside, but even that comes with a bonus, in that this has a bigger battery than the Air 2 — in fact, it's even bigger than the 9.7-inch iPad Pro. That's especially interesting when

you pair it with the new processor, which is an Apple A9, as seen in the iPhone 6s. It's not, you'll note, an A9X processor, which is what the 12.9-inch iPad Pro models run — basically, a beefier version of the same chip.

This means you've got a power-sipping phone processor that's paired with a battery nearly five times larger. The main power draw on a tablet is the screen, and the iPad fifth-gen (as Apple is calling it, apparently pretending that the Airs didn't happen, a bit like when *Superman Returns* skipped over the existence of *Superman III* and *IV* — except the Airs were actually good) has a slightly brighter screen than the Air 2, so you'll still get around the standard 10–12 hours of use from it, as you do from other iPads. But in our tests, it does work out as one of the longest-lasting tablets around. It's good for 12–13 hours of video at mid-level brightness, and nearly as much from regular light use such as emailing and web browsing. We think only the

iPad mini 4 was as good for battery life, and that had a much smaller screen. Obviously, games or other really intensive tasks lower the figures a lot to more like 6–7 hours.

The A9 processor is a good step forward from the A8X in the iPad Air 2, despite being a phone chip, rather than a dedicated tablet one. It's a dual-core chip, and despite being slower than the iPhone 7's A10 chip, it's more than fast enough for everything you probably want to do with a \$470 tablet. Apps don't hang, web browsing is fast, everything is totally fluid, and it comes on instantly from sleeping. It's only got 2GB of RAM, but with the way iOS manages apps, this doesn't really get in the way, or slow things down the way it might on a laptop or Windows hybrid tablet. If you want to create or edit an 8K image, you'll want something beefier — the Pro, the Samsung Galaxy Tab S3 or a laptop.

The screen is 9.7 inches, with a resolution of 2,048 x 1,536. There's nothing fancy

about it — you don't get the TrueTone display or wide colour gamut of the iPad Pro. It's just a beautiful, detailed, bright screen that we have no complaints about for the cost.

There are a few minor disappointments here; we'd love to have seen the vastly improved speakers from the iPad Pro, and the camera is pretty lacklustre. It may sound like we're a bit down on the new iPad, but that's only because its improvements aren't the flashy kind. It's exactly what we liked about the iPad before, but cheaper and faster, and comes with 32GB of storage as standard.

■ Matt Bolton

Verdict

Features
Performance
Value



It's not the most exciting update, but this latest iPad is an amazing piece of kit for the price.





PORTABLE USB HARD DRIVE

2TB, \$149; 4TB, \$229 | WWW.WDC.COM

Western Digital My Passport 4TB

A good looking drive that isn't too overpriced.

Although the latest version of Western Digital's portable hard drive is available in five vibrant colours, we were rather taken with the simple and sleek glossy-white model we received for review, as it managed to all but disappear on our white test bench.

WD has revamped the My Passport exterior, going for a Maxibon-like half-smooth/half-textured plastic exterior, which is so square you can securely stack a number of them on top of one another without worrying if they'll topple. They come in 2TB and 4TB capacities locally, which is a little shy of Seagate's new 5TB portable, but will be more than enough space for most. With a sustained read speed of 114.5 MB/s and write speeds of 110.1MB/s, the new My Passport is in the middle of the road when it comes to transfer rates. The 'My Passport for Mac' drive, when partially formatted

to a universal ExFAT format, runs a little slower than its PC counterpart, with respective sequential read and write speeds of 97.97MB/s and 90.97MB/s, but this is common for dedicated Mac drives.

With the 4TB model landing at \$229, making for a cost per GB of \$0.057, it's a good-value drive. The 4TB model is a little weighty, at 267g including the bundled micro-USB cable, but with a total thickness of just over 2cm its compact dimensions mean it's still easy to move around.

As always with WD drives, this unit bundles in a decent suite of security and backup software for both Mac and PC variations to further sweeten the deal.

■ Joel Burgess

Verdict

The revamped My Passport range adds spunk without detracting from performance and value.



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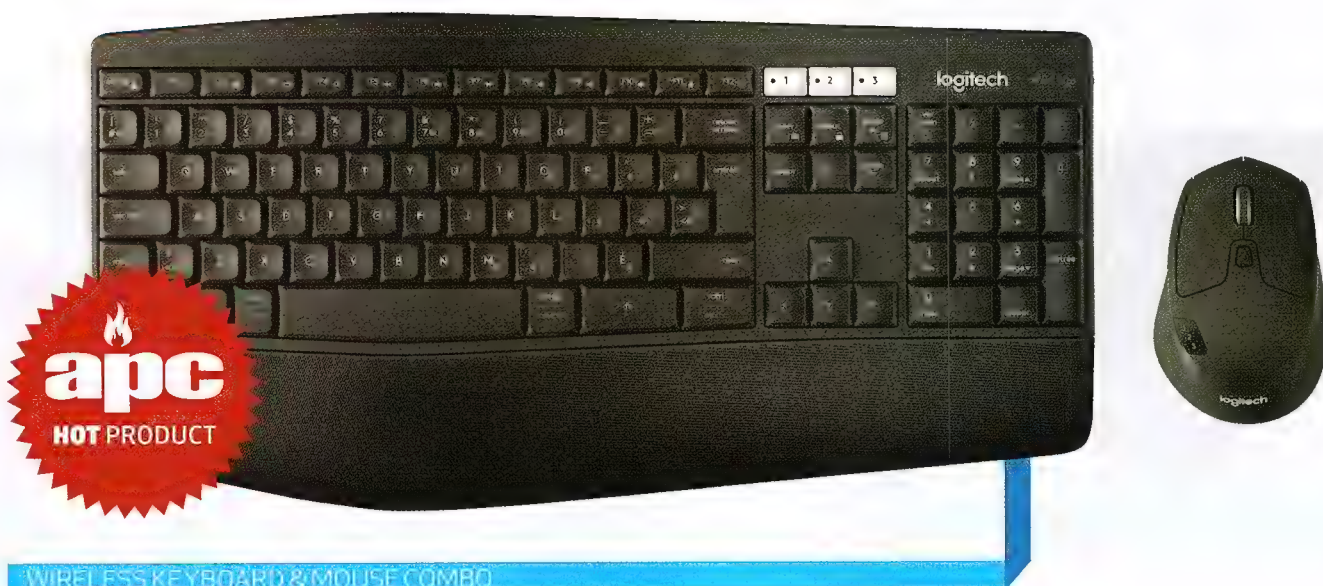


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\$170 | WWW.LOGITECH.COM/EN-AU

Logitech MK850 Performance

A multi-device keyboard and mouse combo for multitaskers... MKey.

Keyboards and mice are the most frequently used bits of equipment in the office, yet these essential PC appendages are often an afterthought, meaning we're left with cheap and rudimentary solutions.

At the other end of the spectrum are combos like this MK850 kit, where an ergonomic design, smart configurable buttons and responsive wireless connection are just a few of the benefits that you'll get over stock keyboard and mouse arrangements. Its real distinguishing feature is just how at home it is being connected to your tablet or smartphone, as it is with your PC or Mac.

The K850 keyboard's played convex design may look as though it was forcefully bent over someone's knee, but its subtle curvature and wider centrepoint make it a particularly convenient layout for prolonged typing. This curvaceous facade is bordered at the bottom by a

soft silicone palm rest, creating a gentle incline and a comfortable rest for your hands. Whether you have it set at a 0°, 4° or 8° incline, this cushion manages to feel comfortable and always sits flush with the table.

We were a little concerned about the light resistance offered by the K850's 19mm keys, but a nice concave key design and a deep travel distance combine to create a relatively effortless, yet still precise typing experience.

Another surprisingly convenient feature is the dual markings on keys, which show each key's varying functions on different OSes – such as, the Windows key is also handily marked as the Command key (if you're using a Mac) and each function is marked in a different coloured font that's used consistently for that device-type across the board.

In addition to having a full-sized keyboard layout, there's also a raft of useful functions pegged to the F1 through F12 keys. A few of

the K850's function keys are particularly useful for navigating tablet and smartphone OSes, a feature that makes sense when you can connect up to three devices simultaneously and toggle between them using those clearly marked (and well placed) white keys that sit above the system-commands bank.

The M720 mouse manages to match the keyboard's ergonomic design standard, with a generous and comfortable mouse body that accommodates your entire palm and offers stable and consistent movement. Each of the M720's 10 buttons seem to sit underneath or adjacent to one of your fingers, giving you maximum control with minimal movement. The M720 is also the first mouse we've seen to have its own multi-device toggle that can click between three simultaneously connected Bluetooth devices.

Mouse support varies depending on device, of course, and though, for the most part, the M720's

Bluetooth compatibility is on par with the MK850 (including Windows 8 and 10, Mac OS X 10.10+, Chrome OS and Android 5 + support), it does miss out on the keyboard's iOS+ compatibility.

The Logitech Options application for Mac and Windows is the standout feature of the M720 mouse as it gives you the control to make six of the mouse's 10 buttons anything from desktop screen switches to single click media controls.

With over 33 customisable tasks, the number of configurations is enormous and each action will be appealing to someone.

■ Joel Burgess

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

The asking price will be a hurdle for most, but the improved comfort and efficiency offered is second to none.





IPC CAMERA

\$329 | WWW.DLINK.COM.AU

D-Link Omna 180 Cam HD

Apple's HomeKit gets a boost from its first compatible camera.

The first version of Apple's 'smart home' HomeKit software didn't work with cameras. Fortunately, the company updated HomeKit with iOS 10, and the Home app can now display video and control cameras. That has allowed D-Link to step forward with the Omna.

The Omna camera boasts a resolution of 1,920 x 1,080, and a very effective 180° wide-angle lens. The Omna also includes an infrared night-vision mode and a motion sensor that can send alerts if it detects movement. It can stream live video to iOS devices, but there's no option for online storage, so if you want to store recordings, you'll have to buy a microSD memory card.

It took us a couple of attempts to get the camera set up properly; we couldn't initially connect the Omna app to the camera when using an iPad. The app works on its own, allowing you to view live video from the camera, record onto a memory card, and to adjust

features such as the sensitivity of the motion sensor. The Omna also shows up inside the Home app in iOS 10, showing both the image from the camera, and the motion sensor. That allowed us to create an 'automation' within the Home app that linked the camera to our Philips Hue lights, so that the motion sensor would automatically turn on the lights when we walked into the room.

There are plenty of more affordable cameras available that rely on their own apps to monitor your home, but if you own other HomeKit devices, it might be worth spending a little extra on the Omna so that you can link all of your smart devices together for a truly smart home. ■ **Cliff Joseph**

Verdict

You'll need an Apple TV or iPad to make the most of it, but the Omna is a real step forward.



LAPTOP BACKPACK

\$350 | THENORTHFACE.COM.AU

The North Face Access Pack

A place for everything and everything in its place.

The tough-shelled Access Pack is the most well-designed and beautiful commuter laptop backpack we've seen. Geared toward anyone who needs to carry a laptop and a fairly strict amount of miscellany. It's basically a rigid aluminium frame, with a fully molded EVA foam shell on top that features a flip-top lid to get into the inner cavity. There's little more than a couple of zippered areas on the front of the pack, designed for quick access to gear like your wallet and phone.

Aside from looking glorious in all gold trim, the inside is just as well thought out. The main compartment holds 22 litres and features two small slots for phone or USB hard drive, and a tablet pocket, as well as a couple of additional zippered areas. The back, protected by a waterproof zip, sports a laptop space, as well as a hidden sunglasses pocket. All the gear slots have pull tabs, which lift

your device part-way out, so they're easier to get to.

The padding on the back feels nice and carries really well under load. It also sits high on the back and doesn't restrict your movement — making it a potential hit with inner-city types who like to cycle.

There are a couple of problems, however. It's super expensive, and that rigid shell means it takes up exactly as much space full as empty. It can't be stuffed down on the floor so you have some more leg room on the train, or expand to carry a larger load, and it won't fold flat for stowage. If you can live with that, this is still a beautifully designed backpack that'll store your stuff with class and elegance. ■ **Troy Coleman**

Verdict

A beautifully designed and crafted laptop back that will suit cyclists, commuters and the well-organised.





GAMING HEADSET

\$75 | COOLERMMASTER.COM

Cooler Master Masterpulse

Comfy convertible cans.

The Masterpulse gaming headset's prime gimmick, a set of neodymium-magnet mounted plates which click onto the outside of each ear cup, is a new experience. Properly installed, the plates infer a closed back design; removed, the headset converts to a semi-open config and activates Cooler Master's 'Bass FX' tech for a far-fatter sound – two distinct sounds in one headset, with a completely analogue way of converting from one to the other.

Getting the Masterpulse nestled on your skull is a highly pleasant experience. The ear pads are generous, soft and easily encompass the biggest ears and the oddest-shaped skulls, despite the stiff, fixed construction of the headband. The lightweight aluminum construction only helps long wearing.

The length of the cable is a little disappointing. At about 120cm – or slightly more if you use the included

4-pole to 2x 3-pole adapter – just isn't enough for most desktop PC configurations. It's barely enough, even, to use this headset hooked up to a phone in your pocket.

There's not a massive difference between the two configurations part from a slightly more hollow sound with the Bass FX tech deactivated. At first listen, everything is a little muddy, there's no remarkable high point to the sound stage.

Long-term listening isn't offensive, it's almost fun. It's rich enough in bass to suit gaming very well, if not flat enough for audiophile music listeners, and goes plenty loud without any noticeable distortion.

Get these for a good price and you're going to have a lot of fun. ■ Alex Cox

Verdict

Comfortable construction, customisable sound, but with a muddy soundstage and short cable.



GAMING MOUSE

\$150 | WWW.ASUS.COM/AU

ASUS RoG Gladius II

Completely customisable clicker with a bright upside.

Mice have been objects of scant innovation. Mainly because, really, where is there to go? Well, if you're ASUS, you'll find at least some of that innovation inspiration in the current trend of adding RGB LED lighting to absolutely everything.

As much as we'd like to dismiss it, the LEDs – which hook up to ASUS's Aura Sync lighting protocol – look brilliant, the underlights projecting a halo on to your mousing surface in whatever colour (or colors) you choose.

There's also a new thumb-seated resolution button which, if you're running in high DPI mode, drops the res (slowing your mouse and increasing your accuracy). But this is easy to activate by accident, and not useful for non-gamers. Above is a pair of additional action buttons, quickly activated by sliding your thumb upward. Waggle your middle finger sufficiently, and you'll find a comfortably

notched and rubberised wheel, behind which is a DPI toggle. Reasonably standard mouse stuff. The sensor, at 12,000dpi, is ridiculously sensitive, as are the left and right buttons by default.

Included in the package is a pair of easily swappable stiffer replacement Omron microswitches.

Nothing here is actually brand new, so we need to assess this based on the whole package, rather than any one of its individual features. And as a whole, the Gladius II is pretty damn awesome. It's comfortable to hold in both palm and claw grips, aided by the pleasant textured rubberised edges. The locking detachable cable system works well, too. Its only downside, really, is the price. ■ Alex Cox

Verdict

Great feel, awesome lighting, switchable switches, but for right-handers only and a bit pricey.





"Powered as it is by an RK3288 System on a Chip, featuring a quad-core ARM Cortex A17 running at 1.8GHz and 2GB of LPDDR3 RAM, we can instantly assume that this board is meant to be a 'Pi Killer' and, computationally, it is."

SINGLE-BOARD COMPUTER

~\$95 (OFFICIAL AU AVAILABILITY TBC) | WWW.ASUS.COM

ASUS Tinker Board

Is it a board? Is it a Pi? No, it's another contender for the Raspberry Pi's crown.

The ASUS Tinker Board arrived on the scene with very little fanfare, and seemed to catch everyone by surprise. This was reflected by the lack of software when the board was released: for the first few days, there was no operating system publicly available to run it. But let's put that behind us and take a look.

Powered as it is by an RK3288 System on a Chip, featuring a quad-core ARM Cortex A17 running at 1.8GHz and 2GB of LPDDR3 RAM, we can instantly assume that this board is meant to be a 'Pi Killer' and, computationally, it is. Running the sysbench prime number test for a single core, it took only two minutes and two seconds to compute all the prime numbers up to 10,000, versus the Pi 3 time of 3 minutes, 2 seconds – a full minute quicker!

We repeated the test utilising all four cores and the Tinker Board completed it in 31.34 seconds and the

Pi 3 in 45.7. So we can see there is plenty of power in the Tinker Board's CPU.

The board provides four USB 2.0 ports along with HDMI, micro USB power and a 40-pin GPIO, which is not fully compatible with boards produced for the Raspberry Pi, but can be used with electronic components (LEDs, buttons and so on) to build your own projects. The software to control the GPIO has to be downloaded separately (why it can't be included ready for use, we don't know). It's called ASUS.GPIO and, yep, you've guessed it, it's a fork of the RPI.GPIO library which powered thousands of projects. It works in the same manner, but you won't be able to connect any SPI/I2C devices just yet, as the software isn't ready.

Networking comes in the form of the built-in 802.11(b/g/n) Wi-Fi and Bluetooth 4.0, which uses a PCB antenna for reception, but you can replace the antenna with an externally mounted option to boost your signal. There's also

'Gigabit' Ethernet, but when we tested the bandwidth using iperf, we managed to record just 35.3Mbits/s. However, this is still far higher than the Pi 3 which only manages 11Mbits/s, as it comes via a USB 2 interface. The Tinker Board does not share the Ethernet bus with USB, enabling the higher bandwidth, but still short of true Gigabit speeds.

The ASUS Tinker Board runs a version of a Debian-based distribution, called TinkerOS. It is lightweight and works really well as a desktop, giving the user access to a traditional menu and widgets to control wireless connectivity. You will find the Chromium web browser present, and it did an admirable job with everything we threw at it – except for YouTube. This board is able to play video at 1080p but YouTube videos ran poorly, even after installing an official patch from ASUS. Our test of the *Star Wars Rogue One* trailer at 1080p sadly crawled along in both windowed and fullscreen modes.

We installed Kodi on our test unit and we were able watch HD movies and stream HD content to our device. It worked flawlessly and means that the issues observed are only with streaming content via the web browser, which can be fixed with a future software update.

The ASUS Tinker Board is undisputedly a powerful platform for makers, but no matter what power it may have, it has not managed to claim the crown from the Raspberry Pi, which offers greater documentation and support for those wanting to learn more. This is a board for experienced hardware hackers only.

■ Les Pounder

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Plenty of power, and a capable board for makers, but the software and the community around it need to develop.



software

» APPS FOR ALL THE PLATFORMS



Windows SOFTWARE

7-Zip

The ultimate free tool for zipping and unzipping file archives.

FREE | WWW.7-ZIP.ORG



With hard drives and SSDs now larger and cheaper than ever, you might well wonder just why file compression tools are still needed. Two key reasons are the internet (compressing files means they can be sent and received faster) and security (compressed files can be encrypted and password-protected).

7-Zip is a free, fast and compact compression application that'll let you pack and unpack a wide gamut of files. In addition to the all-important ZIP format, there's support for the creation of over 31 other types of compressed file. The fact that ZIP and RAR files are included is reason enough to install 7-Zip — everything else is basically a bonus. Compression rates in the program's native format are particularly impressive and overall file compression is more than adequate. You can even make self-extracting compressed archives and share them without having to worry about what software the recipients have installed.

7-Zip can be used in two ways. The first option is to fire up the main program window and work with compressed files through the file manager. The second is to use the context menu, which gives you access to a key set of options by simply right-clicking on files. 7-Zip's file manager's interface

C:\Users\ASUS test\Documents\

File Edit View Favorites Tools Help
Add Extract Test Copy Move Delete Info

C:\Users\ASUS test\Documents\

Name	Size	Modified	Created	Comment	Folders	Files
3DMark		2017-04-...	2017-04-...			
4a games		2017-04-...	2017-04-...			
My Games		2017-04-...	2017-04-...			
My Music		2017-03-...	2017-03-...			
My Pictures		2017-03-...	2017-03-...			
My Videos		2017-03-...	2017-03-...			
PCMark 8		2017-04-...	2017-04-...			
WB Games		2017-04-...	2017-04-...			
desktop.ini	402	2017-04-...	2017-03-...			
TombRaider.log	2 715	2017-04-...	2017-04-...			

is a little confusing. Unlike most compression tools, there's no option to create a new compressed archive and then add files to it. Instead, you have to begin by selecting the files and then then compress them.

7-Zip's various configurable settings are likely to be off-putting to a beginner, however. There's little, if anything, in the way of explanation for many of the options. That said, the default settings will work just fine for most people, and key options such as whether an archive should be password-protected or not are fairly self-explanatory.

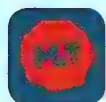
A friendlier way to work with 7-Zip is to use the context menu. After you've selected one or more files in Windows, the right-click menu enables you to add them to a compressed archive in a few clicks. Whether you're looking to save space, secure data or just back up your important data in an efficient manner, 7-Zip has all the bases covered.

Mark Wilson

Shotcut

Professional-looking video made easy.

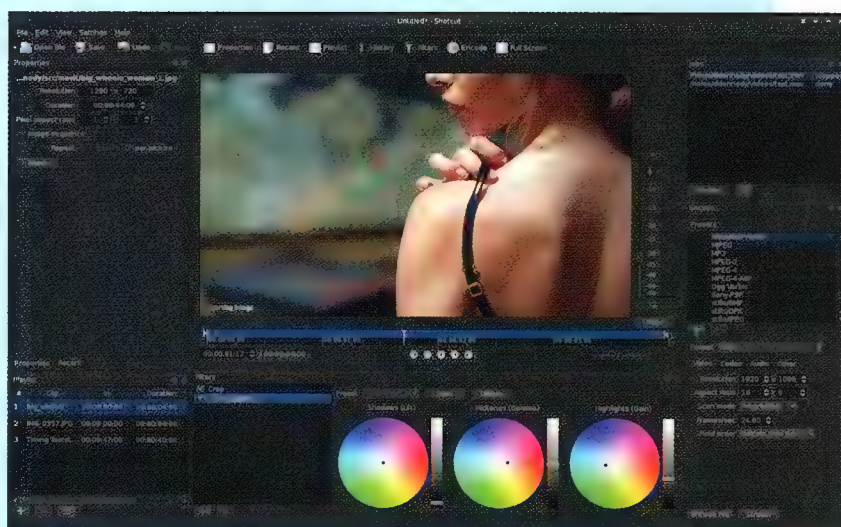
FREE | WWW.SHOTCUTAPP.COM



In just a few easy steps, this open-source program can cut your video footage to a specified length before converting it to a format of your choice. You can also edit your projects with a selection of filters and effects.

The recording function lets you save and edit footage from your webcam, and it can handle streaming in HTTP, HLS, RTMP, RTSP, MMS and UDP formats. Make no mistake: this is powerful enough for a production environment, as well as a great tool for bedroom movie makers and would-be YouTube stars. You get a range of filters and effects, the option to convert to and from a range of formats, some exceptionally useful audio tools and filters and a whole host of new tweaks in this, the 16th version of the app.

It's true open-source software, too, so it won't blast you with ads or try to invade your privacy, and it's available for Mac and Linux alongside this Windows version. Shotcut proves that a top-notch video editor doesn't have to cost a fortune. Cat Ellis





Mac » APPS

Logic Pro X 10.3

Touch Bar support and much more.

\$320; FREE UPGRADE | APPLE.COM/AU

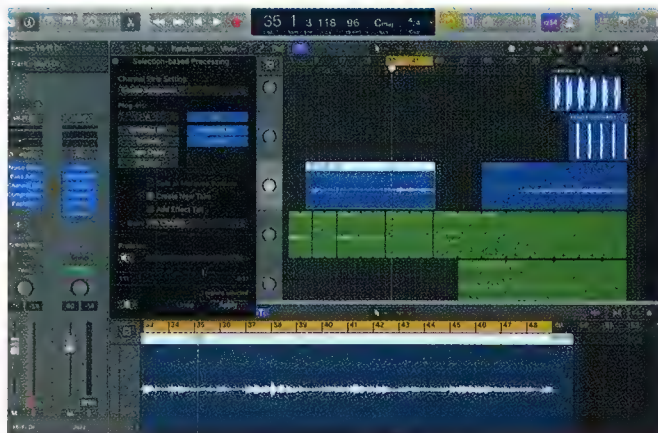


Admittedly, we were beginning to fall a little bit out of love with Logic Pro X. What was once a lean, mean, music production machine had become rather sluggish and crashy, and we found ourselves dreading even simple tasks such as bouncing tracks, because they'd often take down Logic completely. But version 10.3 fixes that, and introduces important improvements.

The most obvious difference is the revised interface, which is flatter, lighter and less likely to give you eye strain. With Advanced Tools turned off, the app looks more like GarageBand than ever, although pro users won't see the fake woodgrain. If you're a GarageBand for iOS user, you'll love the new export feature: you can flatten your project, work on it in GarageBand, and then bring the amended version back in as a proper Logic project again. That's great not just for mobile musicians, but for podcasters, too – you can go out, record new audio and put it straight into your project even when away from your Mac.

The other obvious new feature – if you have a new MacBook Pro – is Touch Bar support, which is very clever. You can use it to control track playback, to get quick access to key effect settings, or to navigate the timeline, and you can even use it to play software instruments or trigger drums.

There are new tools for all other Macs, too. You can now use the Fade tool to fade multiple tracks at once, and the new selection-based processing enables you to apply groups of effects and/or plugins to a selected region or regions. That's particularly useful for fixing the odd fluffed note



or unwanted plosive, but you can also use it to apply all kinds of things to a specific area. The new track alternatives capability enables you to store multiple versions of the same song in one project, so you can play with different arrangements.

Under the hood, the summing engine has been upped to 64 bits – a kind of Retina for audio – and there's support for up to 256 busses, genuine stereo panning and music XML. Software instruments can now trigger sidechained plugins, and MIDI plugins can control other plugins' parameters.

If you're a GarageBand user, it's never been easier to go pro with Logic: with its Advanced Tools off, Logic feels like a kind of GarageBand Pro. **Gary Marshall**

SoundSource 3

Menu control for your Mac's audio.

US\$10; FREE UPGRADE | ROGUEAMOEBACOM

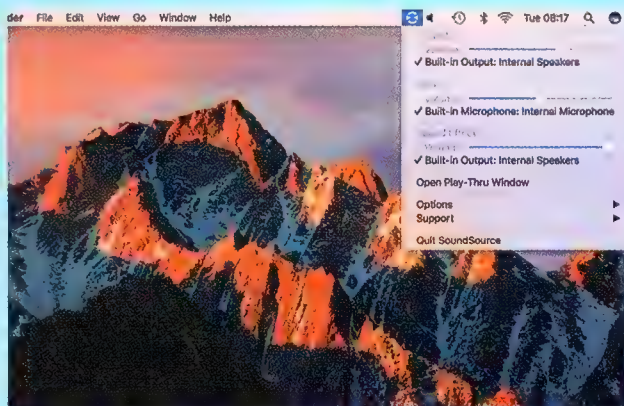


SoundSource claims to be “the sound control that should be built into macOS”. The top three groups in the app's menu are for switching inputs and the destinations for master output and sound effects, each with their own volume slider. Controlling the volume of sound effects is a nice touch if you want to temporarily mute system alerts, for example, yet still want other sounds to play.

The app also provides a Play-Thru window, where you can redirect an input to a specific output device, and adjust the volume/channels used for each device. You might use this to monitor an input through headphones, for example, though output is subject to a slight delay.

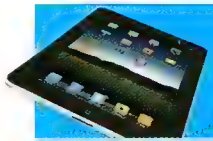
It is a little pricey, and would do more to justify its price if it complemented macOS's built-in keyboard shortcuts for the master output volume with its own for input and sound effects.

The big issue, though, is that while speakers and mics connected by cable or over Bluetooth appear in the list of



available outputs, AirPlay speakers and Apple TV units don't. If you send your Mac's audio to that type of output, perhaps because you have wireless speakers, you may find it better to stick with macOS's built-in control.

Alan Stonebridge



App Store » iOS APPS



RECIPES

SCIENCE

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PHOTOGRAPHY

COMPUTER SCIENCE

TRAVEL

HEALTHY EATING



After Math: Keep pace in the space race

Engadget - 4h · Andrew Tarantola

It's been a productive week for those of us trying to get the hell off this crazy planet. NASA showed off a radiation-proof flight vest for interplanetary astronauts while Blue Origin debuted its latest rocket engine and previewed its upcoming New Glenn...

TheChowdery added to Eclectic Tech, Gaming And Media...
Write a comment...

SCIENCE

Sway

Dance with me, make me sway?

\$4.49 | WWW.PAUSEABLE.COM/SWAY



Disclaimer: It's hard to test a mindfulness app like Sway when you're running on a tight deadline. Plus, it's also hard when your humble reviewer is a mindfulness sceptic. However, perhaps that's a good place to start. Apps don't always have the luxury of being tested at length these days, and people's attention spans are getting rapidly shorter, so does Sway have an immediate hook?

Straight off the bat, it suggests you wear headphones, which is a good move. The music you'll be listening to is beautiful and reminiscent of *Monument Valley*, which is not surprising, since Sway was co-developed by the same team, plus the folks from PauseAble. The calming, soothing tones are accompanied by birdsong and waves, which affected us as designed. You're tasked with swaying with your phone in your hand in a slow, continuous way, then asked to focus on the movement of your phone, to become aware of your body and also, strangely, the sounds around you — which we couldn't hear because we had headphones on. It also sometimes tells you to look away from your phone's screen to better concentrate on your body, which is understandable, but then also puzzling since it gives you instructions and encouragement onscreen that you will then miss.

We like the idea of letting the music take us on a journey, to try to clear our minds and relax, but we're not entirely convinced that the rest of the app is adding weight to this experience. Yes, listening to the music helped us calm down and, yes, the animation on the screen is beautiful with rolling, colourful sand dunes and twinkling sun flares — but does it convert us? For your humble reviewer, not yet, but we're sure it could work for someone else. Carmel Sealey

Flipboard 4

Moving from news to 'magazines'.

FREE | FLIPBOARD.COM



In its earliest incarnation, Flipboard allowed you to view social media feeds and other online content in a stylish viewer that prioritised visual presentation and ease of navigation. Later versions allowed you to 'curate' your own magazines on specific topics by adding links to web pages and feeds, and to share those magazines.

Now, Flipboard takes that concept a stage further with 'smart magazines'. The idea is that, rather than just allowing you to add content from specific publishers or on fairly broad topics, Flipboard 4 drills down to allow you to specify niches within general areas of interest. It then builds a smart mag from social media content and websites, based on your choices. As before, you can 'like' articles and add them to a read-later list, or create a new magazine for them. If an article is of no interest, you can also specify that you want to see fewer like it. Each smart mag has three stories. Tap one and you're taken to the source, flip up to another story.

It all works very well on iPhone: the iPad version hasn't been updated with the new features. However, any mags you create in the iPhone version will be available on your iPad — provided you're logged into the same account.

There are obvious comparisons with Apple News, but these really are two very different beasts. While Apple News allows you to specify the type of stories you want to read, it's limited to publishers who make their content available in the format required by Apple. But that also means that you can read an article without hitting a paywall, something you can't do in Flipboard. Plus, the stories are often a day or more out of date. It's free and uses non-invasive ads to generate revenue. Long-time users may balk at the changes, but for many others, Flipboard just became much more useful. Kenny Hemphill

Karta GPS

Find your own way.

FREE WITH IAP | KARTAGPS.COM

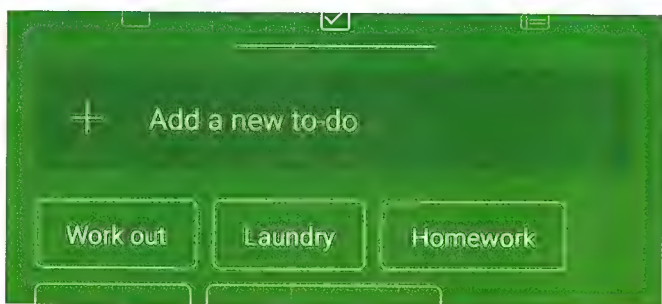
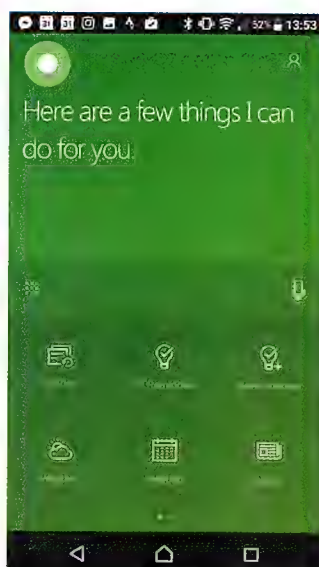
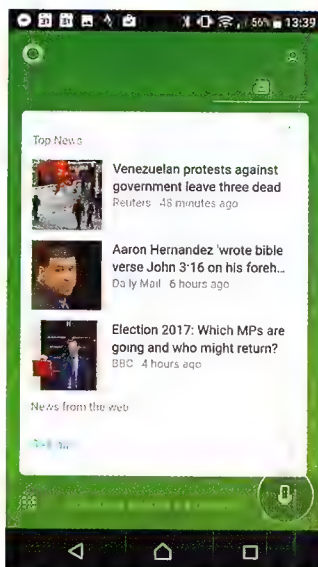


It isn't Google Maps, but Karta GPS is a great alternative that can be used offline. What it does better than Google Maps is help you find your closest meal, drink or tourist attraction. Using the 'search' on Karta GPS gives you the option of "exploring the world around you" that lists places around your location, including restaurants, coffee shops and clubs, and places of interest. You even have the option of choosing a category like shopping, leisure, accommodation or medical services. A list pops up immediately, telling you how far away each option is from you. And given Karta picks up your coordinates, that distance might well be precise.

The user interface is clean and the theme changes depending on the time of day — light for daytime use and dark for night-time. It does its GPS duties perfectly, but what makes it fun are the downloadable voice-overs for directions. My personal favourite — the Nordic god. And if you're travelling, maps from all over the world are available for free to download. Sharmishta Sarkar



Google Play » ANDROID



Cortana

Putting the 'ass' in assistant.

FREE | [TINYURL.COM/APC442-CORTANA](http://tinyurl.com/APC442-CORTANA)



Microsoft's voice assistant has a tough battle. It not only has Siri to knock off her perch, but also Google Now on Android. While it's been available overseas for a while, Cortana now understands Australian accents, though speaks with a soft American lilt.

She's simple to set up, though you need a Microsoft account, and you'll also have to give wholesale access to your phone — voice recognition, calendar, SMS and so on — in order for her to be as helpful as possible. Cortana excels at conversational commands, and is more friendly than Google Now, responding with a chirpy 'Hi!' after you bellow 'Hey Cortana!' to start a search, or figure out what the weather is.

At first, she feels more playful, but the drawbacks are immediate. The app needs to be open to use its function, whereas Siri is always on. You can tell Cortana to text someone, but you'll have to do the typing, and the same goes for setting reminders, making it a lazy — or at least slightly deaf — assistant. Better if you're wed to the Microsoft ecosystem, but install this and your next command will be 'OK Google, I need you to delete an app...' **Paul Taylor**

Converbration

Good vibrations.

FREE WITH IAP | WWW.CONVERBRATION.COM



The drive behind Converbration (conversation + vibration) is to make your phone's vibration alerts as informative as possible, giving you the gist of the message you just received without you having to whip out your phone. By turning off the message alerts for your stock app (it also seems to work for Facebook's Messenger app) and handing over permissions, Converbration will replace whatever your standard vibration is with an incredibly custom series of buzzes. The settings and customisation levels here are nebulous — the vibrations can mimic the actual wording of the message, vary in intensity when it detects excitement or questions, or give off a custom vibration when the content is NSFW or urgent. The service uses AI to scan and analyse your incoming messages and determine the urgency, emotion and nature of their content, and all of this is done locally on your phone, so you don't need to worry about your messages being sent to any remote servers. You get a free 30-day trial of the full features but after that, some of the more advanced options will require \$0.99 for four months or \$3.99 for life. **Harry Domanski**

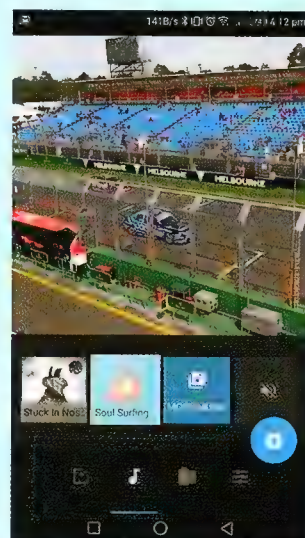
GoPro Quik

Create professional-looking GoPro videos with a few taps.

FREE | QUIK.GOPRO.COM/EN



While it's undeniably fun to shoot action-packed GoPro videos, sorting through all the footage afterwards and then editing it can be a daunting task. That's where Quik comes in. Simply pair the app with your GoPro, select the clips you want to use, and you can have a slickly-edited video that's ready to watch (and share) within minutes. Quik also provides a number of themed templates and royalty-free songs to set your antics to. Depending on the song you choose and the footage available, Quik will even cut the action to in time with the music. Want your video to have a certain vibe? Apply an Instagram-style for instant results. Quik isn't just limited to your GoPro videos, either — you can use the app with any of the videos or images on your smartphone or tablet. Videos are limited to 1080p resolution for now, but that's all you'll realistically need for social media posts anyway. **Stephen Lambrechts**





MTPaint

Painting software with even more enhancements.

FREE | [GITHUB.COM/WJAGUAR](https://github.com/wjaguar)

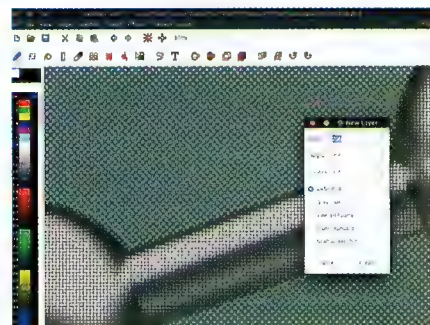
We have another addition to your collection of extremely lightweight productivity applications.

Meet MTPaint, a personal graphic editor written by Mark Tyler back in the days of GTK 1 and initially optimised for decent performance on machines that are a hundred times feebler than your smartphone of today.

We're not talking about ancient abandonware, though. MTPaint has been continuously developed up to version 3.40 (released in 2011), but since then, only few development versions were released. The current MTPaint 3.50 release of nowadays brings an impressive number of enhancements and new features,

and, by the way, it can be safely compiled against GTK2. So you can now enjoy scripting console (Image > Script), support for multiple threads when rendering images (good for multicore CPUs), optional gamma correction for painting, much better text tools, multiple clone tool improvements, a new file format (PMM) and a whole lot more. In the meantime, MTPaint is still a classic graphic application optimised for manual drawing and working with indexed palettes. It requires as little resources as, say, Microsoft Paint from early Windows versions, but in return gives you more advanced tools.

MTPaint supports layers, transparency, selections, up to 1,000 undo steps and up to 8,000% for zooming in. And even that is not the



end of MTPaint's feature-list: how about exporting your artwork to ASCII or turning a multi-layered file into a GIF animation with a few mouse clicks? Alternatively, you can set your own custom keyboard shortcuts for any menu item of the editor, and become a keyboard ninja of bitmaps.

For many common tasks, MTPaint is able to replace GIMP as the main creative tool, so why not give this mighty little editor a try?

Alexander Tolstoy

LanguageTool

A spelling and grammar checker.

FREE | [LANGUAGE TOOL.ORG](https://www.language-tool.org)

When switching from Windows to Linux, there is an abundance of choice of office suites, both open-source and proprietary. But the story doesn't end with proper parsing of DOCX and XLSX files in Linux, because Windows users also expect the same quality of spell-checking as they are used to with Microsoft Word, which contains some proprietary language tools from third parties. LanguageTool is an extension that implements all the usual capabilities for more than 20 languages, mostly European.

It comes as an .OXT file for LibreOffice and Apache OpenOffice and needs to be installed using the standard extension manager (Tools > Extension Manager) from any of the suite's applications. LanguageTool is based on Java 8 and will not work with other office apps in Linux right away.

LanguageTool offers Chrome and Firefox browser plug-ins, a Google Docs plug-in, a cross-platform standalone desktop client and finally an online text input field on the project's website. When used in an office suite, LanguageTool supersedes the default spell-checking engine and offers its own dictionaries together with the grammar check feature. You can tell it's working by the blue underlines that emerge below missed commas, wrong prepositions, duplicate words and other errors. Of course, it won't make your text shine as a professional reviewer could do (Boaster...! — Ed), but at least you'll escape the most common mistakes that occur.

Each LanguageTool release brings more grammar rules and enriches existing dictionaries with new terms and phrases, and the 3.7 version is no exception. Be sure to upgrade if you use Writer heavily!

Alexander Tolstoy

NTFS-3G

A safe and reliable filesystem driver.

FREE | [BIT.LY/203PQ0Q](https://bit.ly/203PQ0Q)

Even though the market share of Windows is (very) slowly declining, in the mid-term, we still use various tweaks to make Linux and Windows' interoperability easier. NTFS-3G is a fully open-source tech. The driver enables handling of NTFS partitions on any non-Windows platform that can work with user-level filesystems, also known as FUSE (`# sudo modprobe fuse`). Along with Linux, the list includes many other OSes, from macOS to OpenIndiana. The NTFS-3G bundle includes the basic part for mounting and the ntfsprogs package for manipulating partitions. You can read, write, resize NTFS partitions without losing data, and as long as the driver has been considered to be enterprise-ready for some time already, using NTFS-3G is quite safe. To mount an NTFS partition, use the following template:

```
# mount -t ntfs3 /dev/sdb1 /mnt/windows
Whereas scanning and fixing possible errors goes like this:
# ntfsfix /dev/sdbX
```

Where 'sdbX' is the name of your NTFS partition. The new release features a few enhancements, such as the ability to mount NTFS volumes in read-only mode in case Windows had put it into the so-called 'hibernate' state, better extended attributes handling, better UTF16 support and more. Generally, the driver has extra fixes and performance fixes that improve writing and reading from an NTFS volume from Linux or another FUSE-compatible OS.

Version 2017.3.23 is the first major update in nearly a year so it will be worth the upgrade if you rely upon NTFS filesystem support under Linux; for instance, having Windows on a separate partition or need to work with external drives formatted with NTFS. Alexander Tolstoy

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\$1,798 | WWW.ACER.COM.AU

Transformative 2-in-1s: change the way you compute

Can't decide between a laptop and a tablet? Why not have both? Nathan Taylor and Joel Burgess test 11 hybrid 2-in-1s.

It's fair to say that 2-in-1s tend to divide computer users into camps. Some people love them – they provide the ultimate in versatility, being a tablet when you need a touch screen and a laptop for when you have some serious typing to do. Other people think that you're just getting the worst of both worlds and prefer separate devices.

We can say that 2-in-1s have got quite a bit better in the past year or two. They've become lighter, better performers and more usable in both forms. Some of the really premium products make excellent tablets and ultrabooks both, with good battery life and performance, as well as highly usable tablet and laptop modes. Unfortunately, those premium products also tend to be very expensive.

This month, we've looked at some of the top 2-in-1s available on the market today, with prices ranging from just under \$1,000 to well over \$4,000.

Acer Spin 7

Looks and feels great, but the battery life is a problem.

A new convertible with a great look and feel, Acer's Spin 7 has a lot to recommend it. It's light but built with a solid aluminium body and hinge that has just the right amount of stiffness, has a really great keyboard and capacious touchpad, and a screen with excellent colour fidelity (though it could use a little more brightness). It performs well enough for a convertible and, in spite of the passive cooling, never got too hot to have in one's lap.

There are also some solid specifications to see here. The Intel Core i7-7Y75 is a capable enough processor with a very high burst capacity (up to 3.6GHz), and with 8GB of memory, it provides a smooth experience for most activity in Windows 10. It has very fast wireless with 2 x 2 MIMO support, as well as a pair of USB Type-C connectors, one of which supports DisplayPort

screens. Thankfully, Acer also includes an HDMI and USB 3.0 adapter in the box, so you can still connect to your older peripherals.

If there's a significant criticism we have of the convertible, it's the battery life. It's turned out to be significantly more limited than most of the competition, falling well below the average at just over four hours in PCMark. This is not a device where you want to be away from a power point for too long. Plus its matte-black metallic finish is a massive fingerprint magnet, which gets grubby very quickly.

Still, it's an overall very good solution from Acer. It's not particularly flashy, just a device with a well rounded and thoughtful design. Recommended.

Verdict

This new convertible is light, solid and pretty, but the battery life will severely limit use.





\$2,159 | WWW.ACER.COM/AU



\$1,700 | WWW.ASUS.COM/AU

Acer Switch Alpha 12

A fair attempt at aping the Surface Pro.

A detachable 2-in-1 that's very much in the vein of the Microsoft Surface Pro, the Switch Alpha 12 is good alternative to the Surface, packing decent specs and produced with a generally thoughtful design. It also works out a little cheaper than the high-end Surface models; the i7/256GB Surface Pro 4 has only half the storage and costs \$100 more.

The model we looked at included the popular Intel Core i7-6500U processor, a mainstay of ultrabooks last year. It produced decent performance in our benchmarks, unsurprisingly similar to the Dell Inspiron 13 7000 Series (see over the page). However, the battery life is a major problem — with a power-hungry processor but small battery, it couldn't even hit four hours in our battery tests.

The Switch Alpha's display is good, a cut above the common Full HD screen in 2-in-1s, although it falls short of the resolution and

quality of the Surface Pro 4, and could use some colour adjustment. The pen system is also a poor substitute.

That said, the keyboard, touchpad and audio are all first-rate. The backlit keyboard has excellent travel and feedback, and is one of the our favourites in the roundup. The fanless cooling system also keeps it completely silent, although it was no cooler in the lap than comparable models.

Ultimately, we'd find it a little hard to recommend the Alpha over a similarly specced Surface Pro. It is a little cheaper and has more storage, but the battery life is a major issue and its screen is not as good.

It's not a bad product by any means, but it fails to stand out.

Verdict

Despite similar specs to the Surface Pro and a great keyboard, battery life is a major issue.



ASUS ZenBook Flip UX360UA

A nice design, elegant and comfortable to use.

Available in Rose Gold or Mineral Grey with a spun metal finish, it can't be denied that the ASUS ZenBook Flip is quite the looker. It's also super light with a very nice balance, just 14mm thick, and yet still has enough space for keys with a comfortable 1.5mm travel. The chassis has a little bit of flex in it, but not enough to be worrisome.

What's more, while we've had problems with ASUS's hinges in the past, we're pleased to see this latest model has stiffened up considerably since the last ZenBook we reviewed. It's still not 100%, but it's steady enough that even strenuous typing won't make the screen wobble.

Although the ZenBook felt good to use, we found the screen a little too much on the glossy side, reflecting heavily in high light and showing up fingerprints a little too easy. The colour definition and sharpness were good, however.

Internally, the ZenBook only has middling specs, at least compared to some of the new models of laptops available. A highlight is its impressive 57Wh battery, though that is somewhat necessary given the relatively power-hungry i5 processor. Even so, it posted amongst the very best battery lives in our tests — six hours.

If you are looking for something that travels well, can hold a charge for a decent amount of time and is comfortable to use for extended periods, then we expect the UX360 is a good choice for you.

It's not the latest and greatest — it doesn't even have a DisplayPort, for example — but it's capable and nicely designed.

Verdict

Light, pleasant to use and with great battery life; but the specs are a bit meh.





\$1,748 | WWW.DELL.COM.AU

Dell Inspiron 13 7000 Series 2-in-1

Not quite up there with the top products.

Looking gorgeous in brushed metal, the Dell Inspiron 13 7000-series is a capable mid- to high-end convertible. It's not as elegant or flashy as the XPS 13 (see opposite), but it's also quite a bit cheaper.

We should note that the review model we received used a slightly older processor, and new 7000 series devices being sold on Dell's site use the i7-7200U and i7-7500U with Intel Graphics 620 – though some with this spec are still floating around at retailers. Even with the older processor, it was still a solid performer in our tests, roughly on par with the XPS 13 in terms of processing power.

The Inspiron is quite a bit heavier and bulkier than much of the recent competition, however, and you will notice the difference when carrying it. There's a fair amount of bezel around the 13.3-inch Full HD screen, which is particularly noticeable in

tablet mode. The screen has excellent clarity but a little too much gloss, making it overly reflective in bright light situations.

The keyboard feels a little shallow, but the touchpad is perfectly responsive, while the audio is middling-to-good for a convertible. There are three USB ports – one of each flavour from USB 2.0, 3.0 to USB 3.1. The latter supports DisplayPort, although there's actually a hard HDMI port built into the Inspiron as well.

Overall, we're not sure we can fully endorse the 7000 series Inspiron. We'd probably recommend spending just a little bit more to get the XPS-13, which has a superior design and screen, as well as better battery life.

Verdict

While this model does do well, its highly-reflective screen and overall bulk works against it.



\$2,799 | WWW.DELL.COM.AU

Dell XPS 13 2-in-1

A nice design and gorgeous screen.

With its aluminium shell and elegant lines, the Dell XPS 13 is quite the looker. It closes super flat and thin, the screen has very little bezel, wasting no space, while the keyboard and touchpad have just the right amount of sensitivity. We were less enthused about how it looks in tablet form, however, with the slightly curved back and rubber feet leaving an awkward gap between the screen and base.

Like most Dell products, there are customisable configuration options, and the XPS 13 2-in-1 can be had for \$2,299 if you're willing to give up half the memory and storage capacity. We looked at the top-level configuration, with 16GB of memory and a top-of-the-line 512GB SSD. That extra memory made a difference in our benchmarks, with the Dell coming out somewhat faster than the similarly configured Acer Spin 7 (back over the page).

The selling point for many people will be its gorgeous screen, a 3,200 x 1,800 InfinityEdge touch display that pushes right to the edge of the convertible and looks great in tablet mode. It's bright and delivers excellent colour and definition. It does have a tendency to pick up fingerprints – a common failing in convertibles. Because of the limited bezel, the webcam also has to sit under the screen rather than on top, which can be a little disconcerting.

Although it's expensive, the XPS 13 is worth the price for its screen alone. It's also light and powerful, and even has a slightly above average battery life. If you can afford it, this is a great choice.

Verdict

Beautifully designed with a great display, it only has a few niggles that you can probably live with.





\$2,899 | WWW.HP.COM/AU

HP Spectre x360 (13-w032tu)

A well-made high-end convertible.

If there's one unit that can challenge the Lenovo Yoga 910 (right) for the title, it's the HP Spectre x360. Like the Yoga 910 and Dell XPS 13, it's a premium product, and it's priced like it, but it's also very well put together.

The one area that it falls down is the screen. You can't get better than a Full HD screen on the Spectre, and while the Spectre's screen is nice, with good colour and the right amount of reflectivity, it can't match the Yoga or XPS 13.

That said, the Spectre also lacks some of the flaws of the Lenovo. Most notably, it contains a set of latest-generation Thunderbolt ports that let you connect to a display while charging from it. There is no SD card reader, however.

The model we looked at uses a high-end (for a convertible) Kaby Lake processor and it shows in the test results, with the Spectre rivalling the best of the competition. What's more, its battery life hit

around six hours under load, which is a very good result.

The backlit keyboard and wide touchpad with multitouch are roomy and relatively well designed, although the keys felt a little too squishy for our liking (but your mileage may vary). We have no complaints about the strength of the hinge, and the quality of the audio that comes out of the HP Spectre is especially notable. It's louder and clearer than the rest of the competition.

Given that it's limited to a Full HD, we can't quite sing the praises of the Spectre – at least compared to the Yoga – but it's a well made and powerful convertible, if a little bland.

Verdict

Great battery, power and design, but suffers from a limited screen and it's rather expensive.



\$3,299 | WWW.LENOVO.COM/AU

Lenovo Yoga 910 (13IKB)

Super expensive but with the goods in nearly every department.

If you're looking for a convertible with the best of everything – and money is no object – then the Lenovo Yoga 910 is the nuts. It's beautifully designed, specced out to the max and as close to the dream convertible as we've seen.

It has about the fastest processor you can find in a convertible, the Core i7-7500U, and that showed in the benchmarks. And lest you think that driving so powerful a processor is going to drain the battery life too fast, don't worry: Lenovo also put a huge 78Wh battery in there, which actually kept the laptop running longer than most of the competition.

And then there's the screen. It's a full 4K UHD packed into 13.9-inches. It's absolutely gorgeous, with near perfect colour and excellent brightness. Like the screen of the Dell XPS-13 (opposite), it pushes right to the edge of the case, with minimal bezel (which does, unfortunately, mean

that the webcam sits below the screen). The speakers are good as well. The overall design is lovely, and the watchband hinge is just right. The keyboard and touchpad are also top notch, with well-regulated travel and sensitivity, and there's a fingerprint reader built in for corporate users. Its one real flaw is the lack of HDMI and DisplayPort, which may be a deal breaker for some. It also has no SD card reader.

You'd probably expect the Yoga 910 to cost the bomb, and you'd be right. We should note, however, you can save \$500 by dropping back to a 512GB SSD, and more by going for a Full HD screen instead... but then you wouldn't be getting everything the Yoga 910 can offer.

Verdict

With a fast processor, great battery and gorgeous screen, this is a winner.





\$800 | WWW.LENOVO.COM/AU

Lenovo Yoga Book

An awesome two-screen hybrid for creative types.

There's no other convertible quite like the Lenovo Yoga Book. Instead of a keyboard, it has a flat touch-and-pressure sensitive plate at the base that works a little like a Wacom graphics tablet. You can overlay it with special paper and write and draw with the supplied pen. That pen contains real ink, so you can write with it naturally and see what you write mirrored on the screen. You can also swap out the ink for a stylus.

For typing, the base has a 'Halo' keyboard instead of real keys. A virtual keyboard on the tablet base lights up and you type like you would on an on-screen keyboard. There's actually some haptic feedback, too. If you demand touch typing speeds, it's probably not for you, though we found we could type quickly enough.

The model we looked at ran a customised version of Android (a Windows version is also available). Lenovo's changes to base Android

are unobtrusive and elegant, and the scribing and drawing apps simple and easy to use.

The hardware also looks great. We can't help but think it would work much better as a detachable than a convertible, and the watch band hinge could use a bit of stiffening, but the screen is great. In tablet mode, it sits very nicely flush, with no gap between screen and base.

Obviously, the Yoga Book is not going to be a product for everyone. But for people to whom this kind of thing is appealing, it's beautifully made, has a nice screen and an amazing battery life and is wonderfully light and portable at only 690g. A top pick.

Verdict

This works well as a creative device and is unique for a convertible.



\$4,199 | WWW.MICROSOFTSTORE.COM

Microsoft Surface Book

Not even a dedicated GPU and long battery life can justify that price.

Late last year, Microsoft refreshed the Surface Book, adding in a faster processor and better GPU. There is a lot to like about the Surface Book – its unique detachable design, the very usable keyboard and trackpad, the great stylus support for creative work. The tablet section, when divorced from the base, is surprisingly light and it was the only 2-in-1 we looked at that included an actual dedicated graphics processor with independent memory. It also has a huge battery – the best of any 2-in-1.

With the NVIDIA GeForce GTX 965M graphics processor, it destroyed the competition in the 3D tests, and is the only 2-in-1 we've seen that's viable for 3D gaming. Its battery life was also the best of the bunch. However, because it doesn't have the latest-gen CPU, it still lagged behind the top devices when it came to general performance. That slightly-behind-the-curve

CPU wasn't the only issue we had either. The too-loose hinge leaves a gap when the book is closed, letting in dust and making it thicker than it needs to be.

There's no Thunderbolt port, and it's heavier than the previous-generation Surface Book. And then there's the price.

Not even the dedicated GPU, long battery life and beautiful 3,000 x 2,000 screen can justify that price tag. The Dell and Lenovo reviewed above have better screens and newer CPUs and are still substantially less expensive. Still expensive, but not \$4,200 expensive. Shave \$1,000 off the cost and the Surface Book is a contender, but right now, that's just too much.

Verdict

Despite its results and functional design, nothing justifies the price you'd have to pay.





\$899 (\$180 FOR TYPE COVER) | WWW.MICROSOFTSTORE.COM

Microsoft Surface Pro 4

A detachable that still holds up pretty well. Great for creative work.

Although Microsoft now sells the Surface Pro 4 with Core i5 and Core i7 processors, those versions amp up the cost quite a lot (although they do also come with the Surface Pen in the box, which the Intel Core m3 version, tested, does not). It actually doesn't compare too badly.

The significant Turbo potential of the m3 processor – up to 2.2GHz from its base of 900MHz – did not put it as far behind the pack as you might expect in the benchmark results. Its battery life was also very good.

Regardless of your choice in processor, you still get the fantastic screen and excellent overall design of the Surface Pro 4. The screen is better than many more expensive devices, greater than Full HD resolution and boasting vivid colours and contrast. It is a little too reflective under bright lights, however. It also works wonderfully with the (sold

separately) Surface Pen for creative work.

The Surface Pro 4 continues to use the detachable system first introduced in the original Surface. It uses a light keyboard attachment, the Type Cover, that magnetically snaps shut and is comfortable and easy to use. (We will say it is a little cheesy that Microsoft still sells the Type Cover separately, for a way-too-expensive \$180, when it's pretty much an essential component.)

Overall, the Surface Pro 4 holds up well. The design is as great as it ever was, it's inviting and comfortable to use and the excellent screen and stylus support make it perfect for creative endeavours.

Verdict

Comfortable, well designed and with a great screen, creative users will enjoy this.



\$2,915 | WWW.MYTOSHIBA.COM.AU

Toshiba Portégé X20W-D

A lesson in why you shouldn't always judge an ultrabook by its cover.

After casting your eyes and hands over the latest Portégé, we'd forgive you for thinking it was one of Toshiba's low-end, 'high-school laptop'-compliant Chromebooks. Apparently 'premium feel' was one of the things that had to go with the X20W's 'Thinner, Lighter, Faster' brief. And true, stripping some of the pedigree from the exterior design has meant considerable gains in overall weight and functionality.

It's encased in an ultra-light painted magnesium case that we don't expect to be good at resisting damage and is largely responsible for giving the unit its cheap plastic feel.

The X20 is a hybrid that feels natural in both laptop and tablet mode. The well balanced stylus, 12.5-inch 1080p touchscreen and sturdy 360° foldable hinge combine to put the X20W up there with the Surface Pro 4 when it comes to slate-mode performance and versatility.

Yes, the keyboard does have small and mushy keys, and the trackpad could do with more surface area and less asymmetrical edges, but both are still functional.

You'll find the X20W smuggling in a powerful Intel Core i7-7600U, a whopping 16GB of DDR3 RAM and a generous 512GB SSD that's connected via the absurdly fast PCIe bus. All of which add up to a level of performance that's almost inexplicable in such a compact package.

All this power does have its downsides, though. The battery lasts a middling 3 hours and 38 minutes. The matte screen could also perhaps be a little more vibrant. But really, our main gripes with this one are cosmetic and financial.

Verdict

Powerful and functional, but it's very high-priced and feels a little flimsy for a premium ultrabook.



superguide » transformative 2-in-1s



2-IN-1 SPECIFICATIONS

	ACER SPIN 7	ACER SWITCH ALPHA 12 (NT. LB9SA.004)	ASUS ZENBOOK FLIP UX360UA (C4132T)	DELL INSPIRON 13 7000 SERIES 2-IN-1	DELL XPS-13 2-IN-1
WEBSITE	WWW.ACER.COM.AU	WWW.ACER.COM.AU	WWW.ASUS.COM/AU	WWW.DELL.COM.AU	WWW.DELL.COM.AU
STREET PRICE	\$1,798	\$2,159	\$1,700	\$1,748	\$2,799
TYPE	CONVERTIBLE	DETACHABLE	CONVERTIBLE	CONVERTIBLE	CONVERTIBLE
CPU	INTEL CORE I7-7Y75 (DUAL-CORE, 1.3GHZ)	INTEL CORE I7-6500U (DUAL-CORE, 2.5GHZ)	INTEL CORE I5-6200U (DUAL-CORE, 2.3GHZ)	INTEL CORE I7-6500U (DUAL-CORE, 2.5GHZ)	INTEL CORE I7-7Y75 (DUAL-CORE, 1.3GHZ)
MEMORY	8GB	8GB	8GB	8GB	16GB
GPU	INTEL HD GRAPHICS 615 (INTEGRATED)	INTEL HD GRAPHICS 520 (INTEGRATED)	INTEL HD GRAPHICS 520 (INTEGRATED)	INTEL HD GRAPHICS 520 (INTEGRATED)	INTEL HD GRAPHICS 615 (INTEGRATED)
STORAGE	256GB LITEON CV3-SD256 SSD	512GB SSD	256GB SSD	256GB SSD	512GB PCIE SSD
TOUCHSCREEN	YES	YES	YES	YES	YES
SCREEN SIZE	14-INCH	12-INCH	13.3-INCH	13.3-INCH	13.3-INCH
RESOLUTION	1,920 X 1,080	2,160 X 1,440	1,920 X 1,080	1,920 X 1,080	3,200 X 1,800
WI-FI TYPE	802.11AC (2 X 2 MIMO)	802.11AC (2 X 2 MIMO)	802.11AC (2 X 2 MIMO)	802.11AC (1 X 1)	802.11AC (2 X 2 MIMO)
ETHERNET	NO	NO	YES, WITH SUPPLIED DONGLE	NO	NO
PORTS	TWO USB 3.1 TYPE-C PORTS	ONCE USB 3.1 TYPE-C, MICROSD CARD SLOT	TWO USB 3.0, ONE USB 3.0 TYPE-C PORTS, HDMI, SD CARD SLOT	ONE USB 2.0, ONE USB 3.0, ONE USB 3.1 TYPE-C WITH DISPLAYPORT, ONE HDMI, SD CARD READER	ONE THUNDERBOLT 3, ONE USB 3.1 TYPE-C, SD CARD READER
BATTERY TYPE & CAPACITY	4-CELL 2,770MAH	2-CELL 4,870MAH	4-CELL 57WH	3-CELL 42WHR	4-CELL 46WHR
WEIGHT	1.2KG	1.25KG	1.27KG	1.75KG	1.24KG

2-IN-1 BENCHMARK RESULTS

PCMARK 8

- HOME (ACCELERATED)	2,998	3,450	3,003	3,164	3,098
- HOME BATTERY (ACCELERATED)	4:15HR	3:33HR	6:18HR	4:06HR	5:27HR
- WORK (ACCELERATED)	4,040	4,290	4,210	4,256	4,635
- WORK BATTERY (CONVENTIONAL)	4:04HR	3:19HR	6:02HR	3:58HR	5:23HR

CRYSTAL DISKMARK 5

- SEQUENTIAL READ/WRITE (Q32TI)	559.8/512.1	496/438.2	444/412.7	483.2/267.9	1,107.5/601.6
- 4K (Q32TI)	289.1/264.6	295.4/260.8	367.1/256.1	321.3/204.5	396.3/256.4

CINEBENCH R15

- OPENGL (FPS)	29.57	43.4	37.88	42.66	36.45
- CPU (MULTI-THREADED)	204	304	268	298	246
- CPU (SINGLE-CORE)	100	125	112	124	127

3DMARK (2013)

- ICE STORM UNLIMITED	48,727	44,691	38,459	45,329	52,145
- CLOUD GATE	4,400	4,995	4,690	5,018	5,038



HP SPECTRE X360 (13-W032TU)	LENOVO YOGA 910 (13IKB)	LENOVO YOGA BOOK (ANDROID)	MICROSOFT SURFACE BOOK	MICROSOFT SURFACE PRO 4	TOSHIBA PORTÉGÉ X20W-D
WWW.HP.COM/AU	WWW.LENOVO.COM/AU	WWW.LENOVO.COM/AU	WWW.MICROSOFTSTORE.COM	WWW.MICROSOFTSTORE.COM	WWW.MYTOSHIBA.COM/AU
\$2,899	\$3,299	\$800	\$4,199	\$899 FOR SURFACE, \$180 FOR TYPE COVER	\$2,915
CONVERTIBLE	CONVERTIBLE	CONVERTIBLE	DETACHABLE	DETACHABLE	CONVERTIBLE
INTEL CORE I7-7500U (DUAL-CORE 2.7GHZ)	INTEL CORE I7-7500U (DUAL-CORE 2.7GHZ)	INTEL ATOM X5-Z8550 (QUAD-CORE 1.44GHZ)	INTEL CORE I7-6600U (DUAL-CORE 2.6GHZ)	INTEL CORE M3-6Y30 (DUAL-CORE 900MHZ)	INTEL CORE I7-7600U (DUAL-CORE 2.8GHZ)
16GB	16GB	4GB	16GB	4GB	16GB
INTEL HD GRAPHICS 620 (INTEGRATED)	INTEL HD GRAPHICS 620 (INTEGRATED)	INTEL HD GRAPHICS 400 (INTEGRATED)	NVIDIA GEFORCE GTX 965M (2GB GDDR5)	INTEL HD GRAPHICS 515 (INTEGRATED)	INTEL HD GRAPHICS 620 (INTEGRATED)
512GB SSD	1TB SSD	64GB SSD	512GB SSD	128GB	512GB PCIE SSD
YES	YES	YES	YES	YES	YES
13.3-INCH	13.9-INCH	10.1INCH	13.5-INCH	12.3-INCH	12.5-INCH
1,920 X 1,080	3,840 X 2,160	1,920 X 1,200	3,000 X 2,000	2,736 X 1,824	1,920 X 1,080
802.11AC (2 X 2 MIMO)	802.11AC (2 X 2 MIMO)	802.11AC (2 X 2 MIMO)	802.11AC (2 X 2 MIMO)	802.11AC (1 X 1)	802.11B/G/N/AC (2 X 2 MIMO)
NO	NO	NO	NO	NO	NO
ONE USB 3.1 GEN 1, TWO USB 3.1 TYPE-C (WITH THUNDERBOLT)	ONE USB 2.0, ONE USB 3.0, ONE USB 3.1 TYPE-C	SD CARD READER	TWO USB 3.0, MINI DISPLAY- PORT, SD CARD READER	ONE USB 3.0, MINI DIS- PLAYPORT, MICROSD CARD READER	ONE USB 3.0, ONE USB TYPE-C
3-CELL 57WH	78WH	8,500MAH	81WH	38.2WH	3-CELL 44WH
1.29KG	1.38KG	690G	1.65KG	766G (WITHOUT TYPE COVER) + 295G FOR TYPE COVER	1.03KG
3,725	3,601	N/A	3,056	2,355	3,277
6:13HR	6:39HR	N/A	6:48HR	5:05HR	3:38HR
4,955	4,992	N/A	3,902	3,077	4,310
5:58HR	6:32HR	N/A	6:40HR	4:55HR	3:31HR
1,355.3/566.7	1,311.4/592.6	N/A	943.1/587.9	576.4/168.7	3,060/1,604
520/389.9	546.4/467.8	N/A	601.6/511.8	233.1/132.6	658.1/570.3
44.42	49.69	N/A	84.5	32.15	41.82
343	348	N/A	301	201	329
139	154	N/A	133	85	139
62,801	64,296	N/A	149,761	42,002	63,885
7,950	8,230	N/A	18,673	4,582	6,235

Most 2-in-1s simply fold the screen back through 360°, which gives a range of different ways to position the device.

While most 2-in-1s use Windows 10, there are some Chrome OS-based devices available.

For 2-in-1 with a detachable screen, you can actually use them gate to gate on domestic flights, unlike laptops which need to be stowed.

2-in-1 tips & tricks: how to use your hybrid effectively

Lindsay Handmer rolls up his sleeves and shows how these once clunky convertibles are now brimming with tricks.

Once unrefined and hard to use, 2-in-1 laptops are now four or five generations along and offer some pretty compelling advantages. The most common designs either detach the screen or fold it back through 360°. Hybrids offer the best of both worlds – a physical keyboard and trackpad for getting complex work done, and a tablet-like experience for working with the touchscreen, use in limited space or just for relaxing.

We've focused on Windows 10 devices, but there are a few Chrome OS-based 2-in-1s available, too. It's not always an easy transition, so we've put together our top tips for getting the most from your 2-in-1 device.

EMBRACE TOUCH

After years of using laptops without touch capabilities, adjusting can be slow. Many users who dislike touch have simply never tried it long enough

to get past the 'it feels weird' part. So use touch as much as possible, and stick with it until you figure out what's truly easier, and what isn't.

KNOW THE CLASSIC 2-IN-1 POSES

Intel did a study and found 2-in-1 users spend around 70% of their time in normal laptop mode. Approximately 20% of the time, 2-in-1s were used (detached or folded up) as a tablet. The final 10% varies depending on model, split between reversing the screen, and folding the device into a 'tent' shape and using the touchscreen.

TOUCH CAN BE FASTER EVEN IN LAPTOP MODE

It will seem weird at first, but when typing, it can actually be faster to reach for the touchscreen rather than the trackpad. We use touch for hitting 'OK' after entering a password, selecting the search box, swiping through images, scrolling, closing a popup or opening an app from the taskbar.

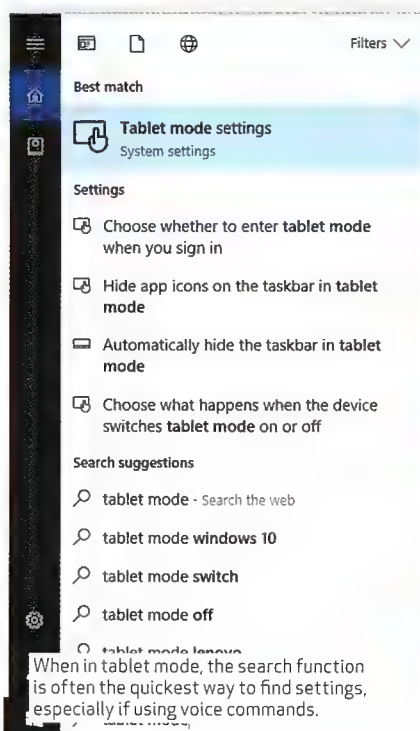
HOW TO MANUALLY SWITCH TO TABLET MODE

Tablet mode should turn on by default when your 2-in-1 is folded or detached. You can manually enable it, and change the default actions under 'Settings > System > Tablet mode'. You can also turn it on or off in the Windows Action Centre (bottom right or 'Windows-A').

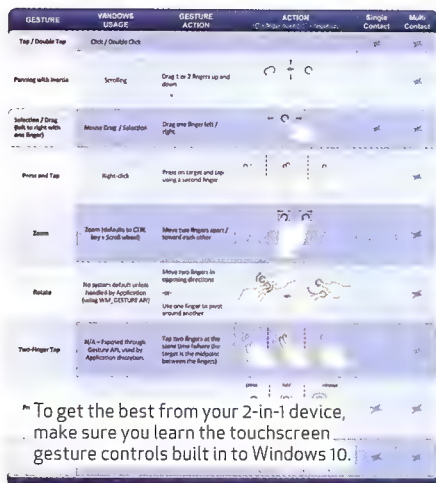
ORIENTATE YOUR SCREEN FOR BEST EFFECT

Like a tablet or phone, Windows 10 will automatically rotate the orientation

Upgrade your touchscreen experience with a stylus for writing, drawing or just accurate navigation.



When in tablet mode, the search function is often the quickest way to find settings, especially if using voice commands.



of your 2-in-1's screen when it's tilted. This can be a great way to read websites, which can be better suited to portrait viewing. But sometimes, you don't want it to rotate — open the Action Centre and select 'Rotation lock'.

LEARN THE TOUCHSCREEN GESTURES

In Windows 10, the touchscreen (and compatible trackpads) can recognise a bunch of handy gestures. Microsoft doesn't have a help file on it, but the third-party Win 10 forums site has a good list at goo.gl/N84UYO. The usual tablet options work, such as scrolling, pinch to zoom, as well as tap and hold. To access the action centre, swipe in from the right.

MASTER THE ONSCREEN KEYBOARD

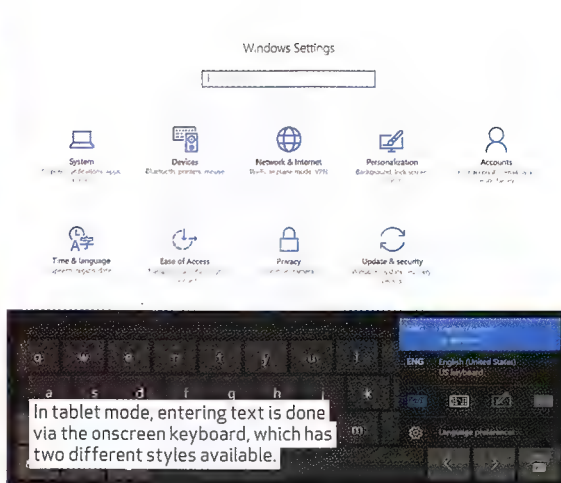
In tablet mode, the only option for finger-based text input is the onscreen keyboard, which should pop up automatically in relevant situations. Otherwise, turn it on using the keyboard icon in the bottom right. With the keyboard open, touch the ENG icon (bottom right) to change the style or jump into the settings.

LEARN TO PITCH A TENT

Also known as 'easel' or 'A frame' mode, this often underused fold has numerous advantages. The shape makes the touchscreen a lot more stable, with no hinge bounce, which is great for heavy touchscreen use, especially when playing games. It also has a smaller footprint, which is ideal for watching movies on a plane or in bed.

HOW TO MINIMISE FINGERPRINTS

Marks on the screen are something 2-in-1 users have to live with, but it doesn't have to affect usability. Make sure your hands are clean, or touch with lesser used fingers. It's possible to buy screen protectors for many models, but they too can get greasy. Make sure to clean the screen regularly with a soft microfiber cloth.



LEAVE THE KEYBOARD BEHIND

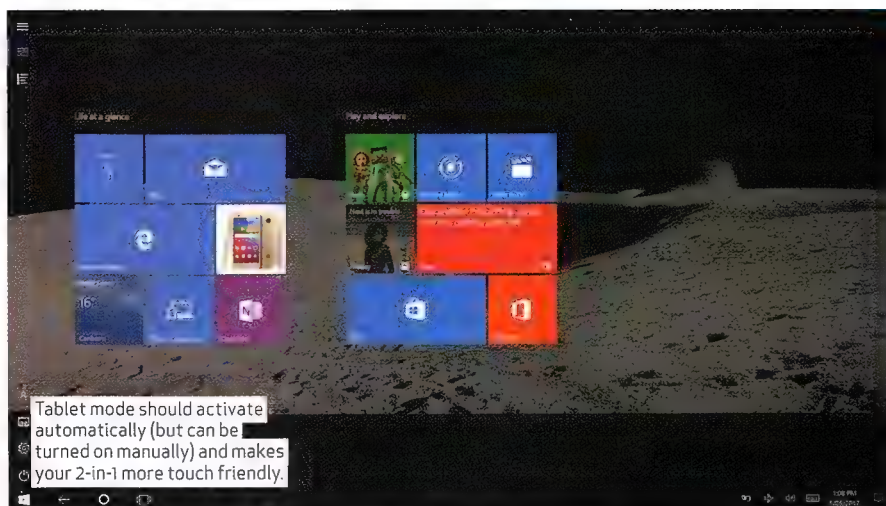
For those with a detachable screen, going sans keyboard on public transport can be freeing. For domestic airline travellers Down Under, tablets (or suitable 2-in-1s) can be used from gate to gate, while normal laptops have to be powered down and stowed away.

BUY A STYLUS

Once you master day-to-day touchscreen use, considering buying a stylus to take it to the next level. Using the appropriate app, you can take handwritten notes directly onto the screen, and save it or convert it to text later. A stylus also turns a 2-in-1 into a powerful drawing and media-editing device, especially on the go when trackpad use is cramped.

AVOID GLARE FOR A BETTER EXPERIENCE

Touchscreens are great, but by necessity, they add a highly reflective surface compared to a matte laptop screen. This can cause real issues with glare and highlight finger smudges, so be aware of your environment and try to position yourself to avoid lighting from behind. Some screen protectors can also add a glare reducing surface.



2-in-1 PC



A 2-in-1 PC, also known as a tablet PC, is a portable computer that shares characteristics of both tablets and laptops. Before the emergence of 2-in-1s, the term convertible and hybrid were already in use by technology journalists.

Hybrids, the term convertible typically referred to, is a PC that features some type of keyboard conversion mechanism that allowed the keyboard to be slid or rotated behind the base of the chassis, while the term hybrid typically referred to devices that featured a non-suggestive complementary keyboard.

Both convertibles and hybrids are convenient devices, combining features of both a tablet and a laptop. However, the 2-in-1 is a sibling to an as well as New categories, divided the 2-in-1 convertible to 2-in-1 detachable respectively, distinct from other convertibles and hybrids due to the presence of features found in traditional laptop computers.

The Microsoft Edge browser is well optimised for touchscreen use, including a pared touch reading mode.

USE YOUR ASSISTANT

In tablet mode, it can sometimes be fiddly to find the specific settings or app you are after. Instead of searching manually, use Cortana and do a search. To avoid the onscreen keyboard completely, try using voice control — it's surprisingly effective with a little practice and really improves the no-keyboard experience.

GIVE MICROSOFT EDGE A TRY

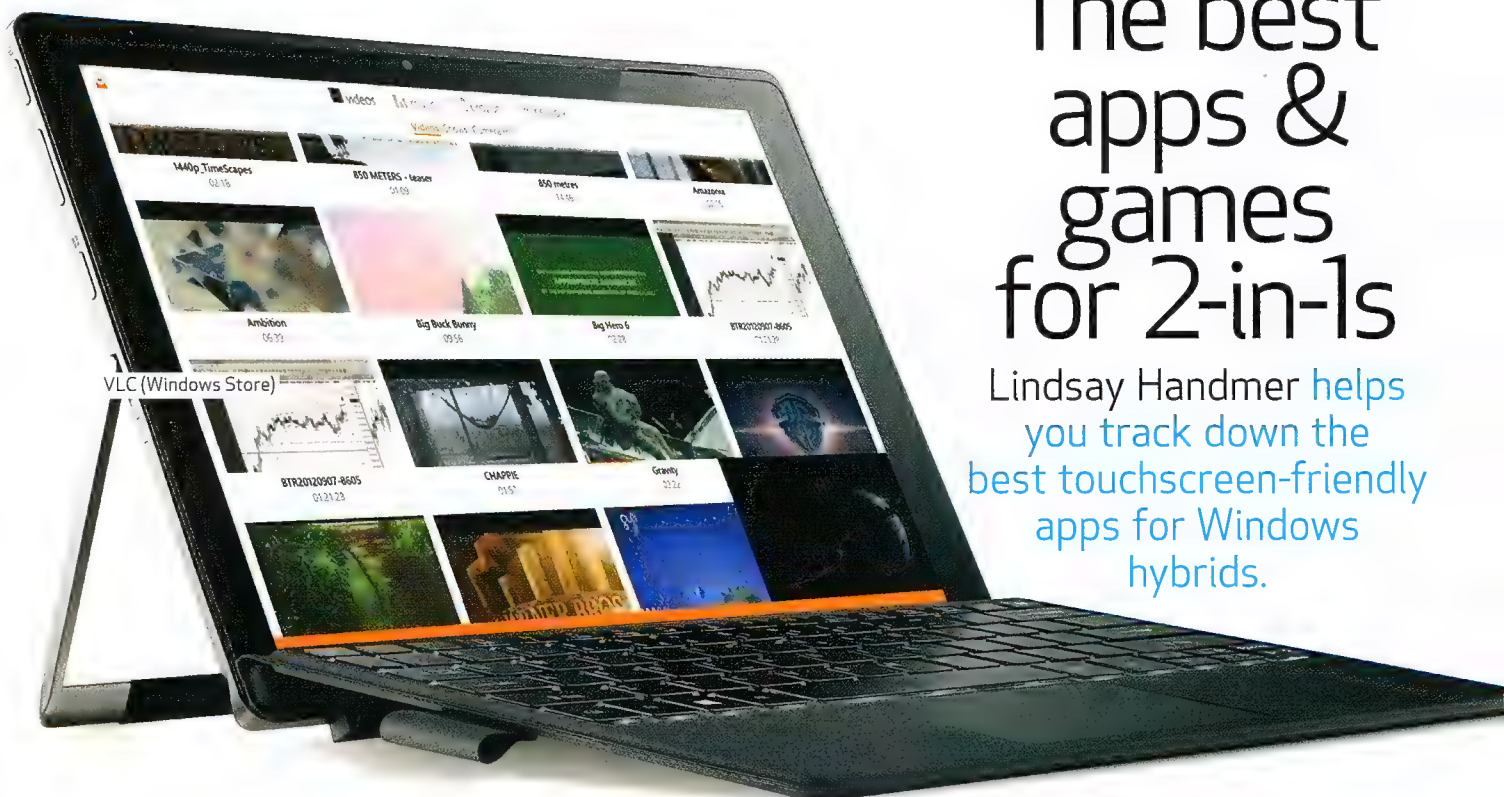
Just like Windows 10 itself, Microsoft has put considerable work into optimising the Edge browser for touchscreen use. While other browsers can be tweaked for touch, Edge has nice big navigation buttons, and a reading mode (the book icon next to the URL bar) that gives a simplified experience on compatible websites.

MORE THAN JUST A LAPTOP

Laptops often spend the majority of time unused, but with a 2-in-1, it's easier to think outside the box. Flip your device into tent mode, start a Google Photos slideshow, and sit it on a bookshelf for an instant digital picture frame. Or during parties, load it with music, so guests can flip through and select tracks. There's so much you can do with a hybrid. Get creative! ■

The best apps & games for 2-in-1s

Lindsay Handmer helps you track down the best touchscreen-friendly apps for Windows hybrids.



Windows 10 makes using just about any app or game possible with a touchscreen, but developers are increasingly including native touch support that can provide a much better experience. A good rule of thumb is that, if the app or game also has an Android or iOS version (or is ported across to Windows), the developer will have included improved touch control. While many desktop applications don't focus on touch, Windows has the Universal Platform, where compatible apps will work across multiple devices, from tablets, PCs, Xbox and even HoloLens.

The Windows Store is a great place to start looking for apps – while you can't filter results for Universal Apps, the description of each app does show what devices it works on and if touch is specifically supported. Similarly, touchscreen-focused games can be hard to find. Another good place to start is Steam, which has a 'Touch Friendly' tag, allowing you to search specifically for touch friendly games.

In general, though, simpler apps and games work better with touch, whereas highly cluttered or complex UIs lend themselves better to keyboard and mouse control. It's well worth owning a stylus with a 2-in-1, as it adds a lot of extra capability, and fine control, to your touchscreen interactions. To help get you started, we've put together a list of our favourite Windows 10 apps and games with touchscreen support.

APPS

VLC (WINDOWS STORE)

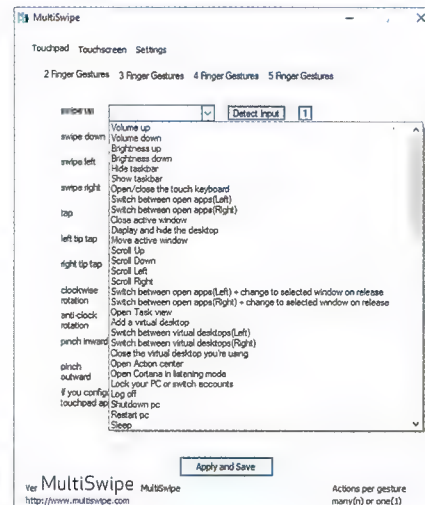
www.videolan.org

A media player is a must have on any PC, and doubly so on a 2-in-1. VLC, already our favourite, has a Windows Universal App. It's fully touch ready, and you can easily swipe, tap and scroll to navigate and play your media. Compared to the desktop version, the icons are large and easy to press, the layout intuitive and the settings have been simplified. It also automatically finds your available media, including network shares, so you can jump right into watching. About the only downside compared to the desktop app is lack of DVD player support, which is a non-issue on 2-in-1s anyway.

MULTISWIPE

www.multiswipe.com

Learning the built-in Windows 10 touchscreen gestures is a great way to make your 2-in-1 experience faster, more productive and more enjoyable. But there are limited gestures available, so MultiSwipe has a third-party solution to create your own. You can set custom actions, such as launching a specific app or adjusting volume, to up to 88 different built-in gestures, including ones with up to five fingers. The gestures also work on compatible touchpads, allowing you to streamline your 2-in-1 use. The app is free to try for 15 days, or around \$7.50 to buy.

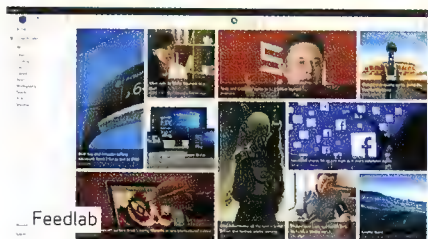
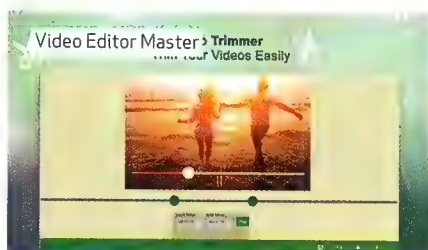


STREAMING VIDEO APPS

2-in-1 devices are great for media playback, but desktop apps or browser based video can be fiddly to use with a touchscreen. Streaming services Netflix (netflix.com.au) and Stan (stan.com.au) both have touch control-focused apps available in the Windows Store that are miles better than using a browser.

Google hasn't made a YouTube app for Windows, so our favourite third-party alternatives for getting your YouTube fix are Tubecast (goo.gl/BMS5Nu) and Hyper (goo.gl/PfTGX5). Both allow you to log in, and give an excellent experience when using your 2-in-1 in tablet or laptop mode.

Many other popular streaming services have official or third-party



touch-ready Windows 10 apps available on the store.

VIDEO EDITOR MASTER

www.queenloftapps.com

Once you get the hang of it, touchscreen-based video editing can be quite quick and intuitive. Unfortunately, our favourite Windows desktop apps don't work too well with touch, but there are a few solid Windows Store alternatives. A good place to start is Video Editor Master (free with a paid upgrade to remove ads), which handles the basics yet



still has a few more advanced features. You can trim multiple videos and merge them, create slideshows, apply filter effects, add text overlays, adjust brightness and sharpness, and attach different audio.

ADOBE PHOTOSHOP EXPRESS

www.adobe.com

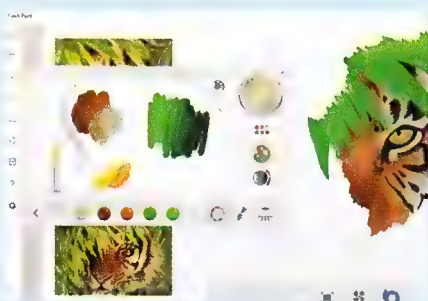
For on-the-go photo editing, it's hard to go past Adobe Photoshop Express. It's free (though needs an Adobe ID for the full features), and is specifically designed for easy touchscreen use without sacrificing more in-depth

controls. Photoshop Express makes it simple to tweak and improve photos, with focus on automatic fixes and filters. Those who want the full on editing experience, the Adobe suite of desktop apps also supports touch use, including gestures and stylus use. Keep in mind, though, fine control is not really possible just using fingers.

FEEDLAB

www.clevlab.com

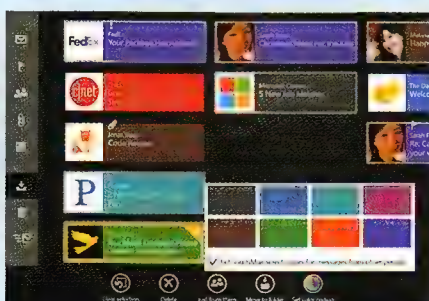
Jumping between browser-based news sites is slow and not very intuitive via touch — fortunately, there is a range of



FRESH PAINT

www.microsoft.com

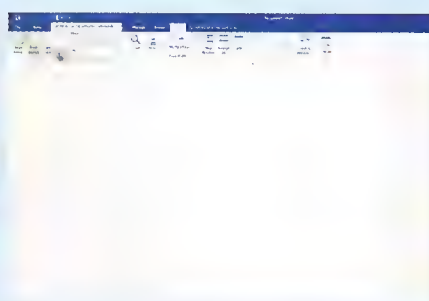
One of the great uses for a 2-in-1 device is turning it into a digital sketchbook. One of the best apps to get started with is Microsoft's own Fresh Paint (free). While a lot of apps focus on stylus use alone, Fresh Paint fully supports drawing with finger touch (as well as stylus use), and can import photos and images to use as part of your artwork. For more advanced stylus users, check out Sketchable (free with paid upgrades, siliconbenders.com), which has a much more in depth interface, while still remaining easy to use.



TOUCHMAIL

www.touchmail.co

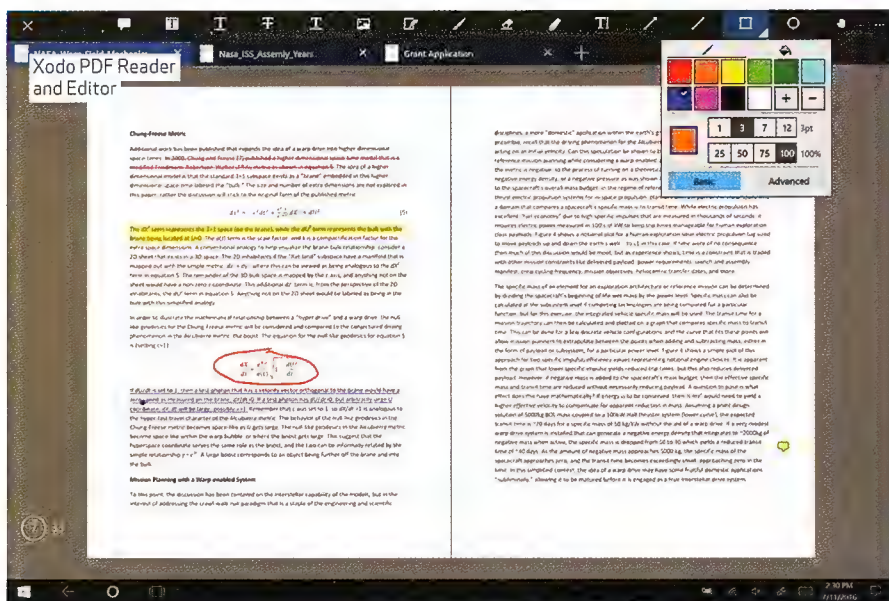
Browser based email or even Microsoft's own Win 10 app does the trick, but for 2-in-1 use TouchMail is the ultimate solution. The app is free (with paid upgrades) and has been purposefully designed for use with touchscreens, as well as stylus, and of course keyboard and mouse. It handles IMAP accounts (so Outlook, Gmail etc) and can bring multiple accounts into the one spot. The app uses a visual based layout, with colours, zooming and tabs to make handling a big inbox easy. It also integrates with all the major cloud storage services for direct email attachments.



MICROSOFT OFFICE SUITE

www.microsoft.com

Apps such as Word as not so easy to navigate with fingers, but Microsoft has included a Touch Mode that spaces everything out a little more for easier tapping. It should activate automatically when you enter Tablet mode, but it can also be turned on manually. First, open up the customise the quick menu (a little triangle with a dash above it, top left) and select Touch / Mouse Mode. Now there should be a new touch icon in the toolbar - tap it to select touch or mouse mode. For those with a stylus, most of the Office apps make it easy to scribble on, highlight and interact with a pen.



Windows 10 apps that give a much better experience. FeedLab (free, with in app purchases) is one of our favourite news aggregators, which can be set to grab the news you want from your favourite sites, and allows you to customise layout, size and even colour themes for your tastes and device. Flipboard (free, flipboard.com) is another similar app, but with more of a magazine feel and social media integration. For research, try Wikio (free, goo.gl/o9GqTO), which gives

streamlined access to Wikipedia that suits touchscreen use.

XODO PDF READER AND EDITOR

www.xodo.com

2-in-1 devices have made PDFs into a much more versatile, editable, collaborative format. Xodo is free, designed for touch use, and is a fast and easy way to view PDFs. But it also allows you to edit and interact through touch – both with fingers and a stylus. You can zoom, search, highlight, jot

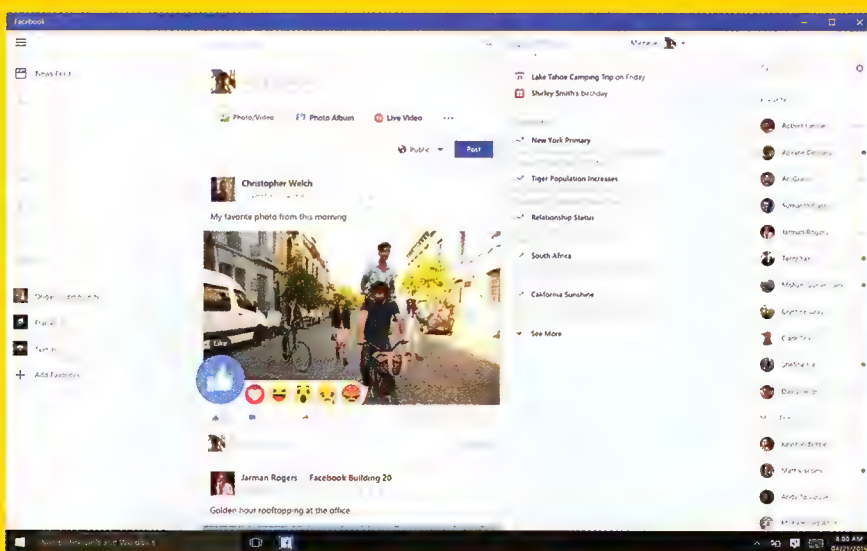


down notes, circle important info, make bookmarks, crop pages, create new PDFs and more. You can even collaborate with others on the same file. Xodo also allows you to digitally sign documents, and has a solid built-in file manager.

STAR CHART

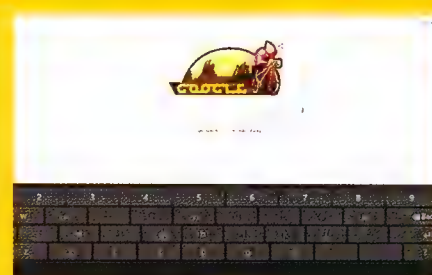
www.escapistgames.com

Touchscreens are great, but 2-in-1 devices also have other tablet like hardware, such as cameras, GPS, accelerometers and magnetometers. Taking advantage of that is the augmented reality app Star Chart (free, with paid upgrades), which creates a virtual window into the universe. Simply point your device up at the sky and the app will orientate itself, and help explain what you are seeing. From identifying planets and stars, to tracking satellites and the International Space Station, it makes astronomy fun. You can also get close up looks at faraway planets.



SOCIAL MEDIA APPS

For those who love to stay connected, using social media sites through a browser can be a mixed bag. Compared to the smartphone app versions, sites such as Facebook can be very clunky to use by touch. A better option for 2-in-1s are the dedicated Windows 10 apps with proper touchscreen support – though there are still a few caveats. Like on mobile, Facebook annoyingly splits Messenger into a separate app. The Win 10 Twitter app is quite good, but those who like to use Instagram will be disappointed by the simplified official option. Instead, check out InstaPic (free, goo.gl/B17H7o), which has a lot more depth, though a less touch friendly UI (but still better than a browser).



BROWSER UPGRADES

Unlike mobiles and actual tablets, accessing the internet on 2-in-1 devices can be frustrating, as the browsers are not really well optimised for touch use. Microsoft's Edge is fairly well laid out, with large icons, support for gestures and a simplified Reader mode. We still prefer Google's Chrome, though, which supports gestures, but doesn't have a particularly easy UI for touch. On the plus side, Chrome extensions can add some functionality. A good place to start is Virtual Keyboard, by xonTAB (www.xontab.com), which automatically pops up when a text input is detected, then closes afterwards, like the keyboard on your smartphone.



GAMES

CIVILISATION V

www.civilization5.com

One of the most well-known turn-based strategy games available, *Civilisation V* is a great choice for more powerful 2-in-1s. The game has been specifically optimised for use with a touchscreen and, despite a few niggles, has an intuitive UI that makes for easy gaming. Lead a civilisation from the dawn of man into the space age, compete with players around the world, or just enjoy the impressive graphics. It's not a cheap game (~\$100, or US\$70) but a great choice for those who want something very in depth. Make sure to check the system requirements, and download it via Steam.



MINECRAFT: WINDOWS 10 EDITION

www.mojang.com

For an endless variety of gameplay, it's hard to go past *Minecraft*, the Lego of games. The new version brings touch support, making it perfect for playing on 2-in-1 devices. You can play with friends across different platforms, too, or just explore and create on your own realm. The game costs \$10 on the Windows Store, but owners of the original game can register and grab it for free – though, it won't support your old worlds or previous saves. For those unsure, there is a free trial available, with 90 minutes of gameplay to see if it's for you.



TENTACLES: ENTER THE MIND

www.pressplay.dk

For something a little off the wall, there isn't anything better than a weird tentacle game published by Microsoft Studios. A combination puzzle and adventure game, you play as Lemmy, an endearing fantasy blob, as you swing, jump, fight and explore wonderfully colourful yet bizarre worlds. The game includes touch support, and is easy to casually play on a 2-in-1 device. You can save games to the cloud, and play across multiple devices. It's free, too (with in-game purchases), and available for download from the Microsoft store.



HALO: SPARTAN STRIKE

www.halo.com

Affordable, yet loads of fun, *Spartan Strike* is a top-down shooter that lets you relive some of the fun of the classic *Halo* series. The game is designed to be played via touch (as well as keyboard and mouse, or Xbox controller) using virtual joysticks. You play through 30 levels, including the endless fun of mowing down enemies in a Warthog, or taking them out with a Kestrel VTOL aircraft. The game costs around ~\$4 on the Microsoft Store (though is also available via Steam) and only needs fairly modest hardware.



HITMAN GO

www.hitmango.com

A perfect complement to a 2-in-1 touchscreen, there are loads of great puzzle games. But one of our favourite puzzlers with more depth is *Hitman GO* (Steam, ~\$13, www.hitmango.com). As the name suggests, you play as a hitman, and have to strategically navigate a gridded world to take out enemies and infiltrate locations. By the same developer, *Lara Croft GO* (Steam, ~\$15, www.laracroftgo.com) is an endless stream of puzzles, traps and lush landscapes with a simple touch interface and a great soundtrack. Popcap games such as *Bejewelled* are a great choice for simple yet addictive fun. And don't forget classics like *Minesweeper*, available for free on the Windows store.



CRAFT THE WORLD

A 2D side-on sandbox strategy game, *Craft the World* can provide loads of entertainment. You command a tribe of dwarves in a randomly generated world full of resources and dangers, you guide your clan, build a dwarf fortress, craft item and weapons and battle enemies. As a divine being, you have access to magic spells that can be used to help your dwarves survive, and eventually thrive in their world. *Craft The World* works well on touchscreens, and its modest hardware requirements allows it to run on just about any 2-in-1. Grab it on Steam for about \$25.



HEARTHSTONE

There are loads of fun recreations of existing card and board games that all work fairly well with touch. But one of the most fun, yet totally unique games available is *Hearthstone*, by Blizzard. Built around the *Warcraft* series lore, the game is turn-based, with the end goal to use spells and minions to reduce the opposing player's health to zero. You can earn new cards by playing (or buying them) and compete with other players across multiple platforms. It's free to play, simple yet addictive (like all good games) and a great choice for 2-in-1s.



PLANTS VS ZOMBIES

One of the classic game types for touchscreen use, tower defence games abound and most work well on 2-in-1s. One of our favourites is *Plants VS Zombies*, where you defend your home from the undead with a nursery full of crazy plants. The game costs - \$7.50 on Steam, though there is a free demo available. For a fantasy-focused tower defence, *Kingdom Rush* and *Kingdom Rush Frontiers* (www.kingdomrush.com) pits you against endless hordes of orcs, trolls and evil wizards. Both games are available through Steam, for about \$15 each.



CONTRAPTION MAKER

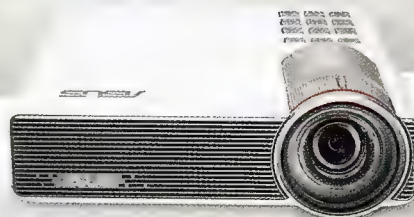
Physics-based games are a great match for touchscreen-based play on a 2-in-1, and there are loads of great options available. From the makers of *Incredibles Machines*, *Contraption Maker* (Steam, - \$15) has you solving puzzles with Rube Goldberg machines built around hamster motors, trampolines, alligators and other wacky fun. *Crayon Physics* (Steam, - \$30, www.crayonphysics.com) allows you to create machines and solve puzzles with your own drawings, and is ideal for use with a stylus. Another great physics-based game is *World of Goo* (Steam, - \$15, www.worldofgoo.com), where you solve puzzles with structures built from Goo Balls.



BALDUR'S GATE: ENHANCED EDITION

Turn-based RPGs often work quite well with touchscreen, and especially older titles run just fine on 2-in-1 devices. The *Baldur's Gate: Enhanced Edition* (via Steam, - \$30) is a good place to start and includes the entire *Baldur's Gate* adventure, as well as new content. Likewise, the *Planescape: Torment: Enhanced Edition* (Steam, - \$30) updates a classic *Dungeons and Dragons* multiverse game with a rich story and loads of gameplay. For a fun retro pixel art take on the turn-based RPG game that's very touch friendly, check out *Knights of Pen and Paper* (Steam, - \$15).

P3B



S1



E1



Portable. Personal. Professional

P3B PROJECTOR

- 800 lumen long-life LED
- Ultra short thrown lens
- Built in 12,000mAh battery with up to 3 hours projection time

S1 PROJECTOR

- 200 lumen long-life LED
- Built in 6,000mAh battery with up to 3 hour projection time
- High capacity power bank

E1 PROJECTOR

- 150 lumen long-life LED
- Projects visuals up to 120"
- Built in 5,000mAh battery with up to 5 hours projection time

Bargain-basement screens

Not everyone needs a high-end monitor, so for those on a budget or who just need a basic screen, we've compared the most affordable options. Lindsay Handmer

To help scope out what was available when it comes to low-cost screens, this month, we've put 10 models to the test, with all models priced under \$300. Of course, at this pricepoint, monitors tend towards simpler models, but there are plenty of smaller panels with higher-end features. It's also possible to buy quite competent gaming models, with functionality such as AMD FreeSync and higher refresh rates. While many cheaper screens use basic TN panels, some step up the quality with VA or even IPS displays.

Other affordable productivity-focused monitors include adjustable stands, or have increased power efficiency.

While it's possible to buy affordable LCDs under 20-inches, 27-inches is about as big as you will find without blowing out the budget and going above \$300.

As always, make sure you shop around for the best price – our sister site www.getprice.com.au is a great place to start. But don't shy away from big name stores such as JB Hi-Fi or OfficeWorks either, who often have some surprisingly great discounts and special offers.

HOW WE TESTED

Each was tested in a range of scenarios at its native resolution, including gaming, productivity, media playback and web surfing. OSD settings were adjusted for best image quality. FreeSync was tested using an AMD Radeon RX 480.



\$200 | WWW.ACER.COM.AU

24 inches; TN panel; 1,920 x 1,080 resolution; HDMI; DVI; VGA

Acer G246HL

A simple 24-inch monitor.

The G246HL aims to provide plenty of screen real estate without a high price tag. The monitor is available as a 24-inch model for \$200, or \$265 for the 27-inch version. Both use a TN panel, with the standard 1,920 x 1,080 resolution. It's also got a 5ms response time, 60Hz refresh rate, 100 million to 1 adaptive contrast ratio and a 250cd/m² brightness.

While the stand itself looks great on a desk, it only has tilt adjustment – no height or pivot. As expected from a TN panel, the viewing angles are a bit lower than an IPS screen, at 170° horizontal, and 160° vertical.

Colours are fairly vibrant and a bit more accurate after some tweaking, and picture quality is reasonable. The backlight is quite even, though there is a touch of light bleed on the edges.

The G246HL has HDMI, DVI and VGA inputs, but only includes cables for the latter two. While the Acer G246HL is a competent monitor, there are better options for similar amounts of money.

Verdict

The G246HL has practically no bells and whistles, but is vibrant and fairly cheap. However, there are better options out there.



\$285 | WWW.AOCMONITORAP.COM/AU

27-inches; TN panel; 1,920 x 1,080 resolution; HDMI; DisplayPort; VGA

AOC G2778VQ

An affordable gaming monitor.

At 27 inches, the AOC G2778VQ is a decent step up from a 23-inch screen, without too much of a price bump. It features a 1,920 x 1,080 resolution, and has a simple but stylish red and black colour scheme with internal PSU. The G2778VQ is aimed at gamers, with a low 1ms response time and gaming modes such as FPS, racing and RTS. It supports AMD FreeSync, and has a 75Hz refresh rate. The screen also has shadow control, which allows the user to improve detail in dark areas.

The AOC gives a great image for gaming, but the TN panel doesn't have the colour accuracy or viewing angles of its IPS brethren. The backlight is bright (300cd/m²) and quite even, and overall contrast is decent and colours vibrant. We experienced no visible ghosting and FreeSync does an excellent job.

Round the back, the AOC has HDMI, DisplayPort and VGA inputs. The inbuilt 2W speakers are nothing special, but handy as a backup.

Verdict

With AMD FreeSync on board, plus shadow control, this monitor will do a good job and for a fairly good price.





\$230 | WWW.ASUS.COM/AU

23-inches; AH-IPS panel; 1,920 x 1,080 resolution; dual HDMI; VGA

ASUS VX239H

Affordable, yet well equipped.

For as little as \$230, the 23-inch ASUS VX239H is well suited as an everyday monitor. For those who want the extra quality, it uses an AH-IPS panel, with a 1,920 x 1,080 resolution, wide 178° viewing angles, 80 million to 1 smart contrast ratio and an ultra-low blue light production backlight.

The VX239H looks great on the desk, with thin (but not quite frameless) bezels and a minimalistic stand with basic tilt adjustment. We did not experience any ghosting at all, thanks to the 5ms response time, and while not really aimed at gamers, the monitor does have gamer modes.

The monitor is quite bright (250cd/m²), with an even backlight and vibrant, accurate colours. The screen has dual HDMI and VGA inputs, with the former MHL compatible for connecting (and charging) mobile devices. Frustratingly, only an VGA cable is included (not HDMI), and the speakers are expectably tinny.

Verdict

For those who need a quality 23-inch screen with a few handy features, you can't go wrong with the VX239H.



\$150 | WWW.BENQ.COM/AU

21.5 inches; VA panel; 1,920 x 1,080 resolution; DVI; VGA

BenQ GW2270H

A compact option.

Measuring in at 21.5 inches, the little BenQ GW2270H is great for smaller desks or as a second screen. It costs just \$150, despite using a higher-quality VA panel with a 1,920 x 1,080 resolution.

Sure, it's not quite IPS territory, but the GW2270H offers true 8-bit colour and wide 178° viewing angles. VA panels also give great contrast, and the BenQ screen exploits that with a high 3,000:1 native contrast ratio.

The refresh rate is quite good at 5ms GTG, and we did not experience any ghosting in normal use, including light gaming. The screen is rated to display 72% of the NTSC colour gamut, and gives a noticeably better image than a TN screen. The GW2270H looks great on a desk, but only has basic tilt adjustment.

Connectivity falls a little short as well, with DVI and VGA, but no HDMI or DisplayPort.

For those who want a larger screen, an extra \$50 gets the GW2470, with the same specs but a 23.8-inch panel.

Verdict

For just \$150, this little screen is a versatile solution, but its connectivity options and size won't be everyone's cup of tea.



Monitor specs at a glance

A quick rundown of all the important numbers and features you need to know when buying a monitor.

Resolution

Don't accept anything under 1,920 x 1,080, but at the same time, it's hard to find higher on a budget.

Inputs

HDMI is best for easy connection, but sometimes DVI or even legacy VGA ports are useful for connecting to older PCs.

Stand

Even the cheapest screens can be tilted, but for productivity use, look for height and pivot adjustments.

Panel Type

IPS is the best quality, but VA panels are almost as good, and are usually cheaper with better contrast.

Size

24-inch (often 23.5-inch) is the sweet spot, but a 27-inch screen is worth considering for those who game or just sit a bit further back.

Response Time

Gamers should look for the lowest response time to avoid ghosting, but for day-to-day tasks, higher is not a problem.

Refresh Rate

Gamers should look for 75Hz or higher, but most affordable monitors have a 60Hz refresh rate.

Gaming

Look for extra technologies such as game modes, as well as technologies such as FreeSync which can help eliminate tearing.





\$199 | WWW.DELL.COM/AU

23.6 inches; TN panel; 1,920 x 1,080 resolution; dual HDMI; VGA

Dell SE2417HG

Get your game on.

The Dell SE2417HG is aimed at gamers on a budget. The 23.6-inch panel has a full HD 1,920 x 1,080 resolution, as well as a 2ms response time. It's a TN panel, of course, with the usual 160° vertical, 170° horizontal viewing angles and an anti-glare coating.

As a more affordable screen, it does not have the full Dell stand – just basic tilt adjustment. Round the back, it has dual HDMI, which is handy for plugging in a console and PC, plus a legacy VGA connection.

The SE2417HG is fairly understated compared to some gaming monitors, with the classic Dell style. The image quality is quite good, all things considered, with bright but not over-the-top colours and an even backlight with no real bleed.

In our testing, we did not experience any ghosting, and gaming was excellent, but the Dell doesn't have any of the adaptive sync features of its pricier competition.

Verdict

This monitor ditches adaptive sync to focus on the budget gaming market. Bust just a little more dosh provides better options.



\$289 | WWW.HP.COM/AU

23.8 inches; IPS panel; 1,920 x 1,080 resolution; HDMI; DisplayPort; VGA

HP EliteDisplay E240

A high quality panel.

Aimed at professionals or those who want top-notch visuals, the HP EliteDisplay E240 provides quality at a decent price. The E240 sports a 23.8-inch IPS panel with a 1,920 x 1,080 resolution and wide 178° viewing angles. Just as importantly, it has an ergonomic stand with a large 150mm height adjustment, as well as tilt and swivel options.

The monitor includes HDMI, DisplayPort and VGA inputs (though only comes with a DisplayPort and VGA cable), plus a two-port USB hub. It's also designed for power efficiency (using 31W) and can have an HP mini PC mounted on the rear for a slim AIO build.

The image quality on the E240 is top notch, with great colours, contrast and even backlighting, though the higher 7ms response time is not suited to gaming. For those who like to tweak their screen experience, the monitor comes with HP's Display Assistant Software.

Verdict

Shop around to find this professional-gearred monitor for under \$300. Gamers, this one isn't for you.



\$250 | WWW.LG.COM/AU

27 inches; IPS panel; 1,920 x 1,080 resolution; HDMI; VGA

LG 27MP48HQ

27 inches of IPS screen.

The LG 27MP48HQ is a remarkably affordable way to upgrade from a smaller monitor. The LG offers a 1,920 x 1,080 resolution, with a high-quality IPS panel and a 16:9 aspect ratio. At 250cd/m², it's quite bright, but can be overpowered by high-glare situations.

The 27MP48HQ has wide 178° viewing angles, a pretty normal 1,000:1 contrast ratio and includes a splitscreen utility for up to four views at once. The response time is a gamer-unfriendly 14ms (GTG) but it doesn't create any ghosting issues in normal use, or even fast paced video. The panel colours are great, though there is some very mild unevenness to the backlighting.

The LG monitor has a single HDMI input, as well as a legacy VGA connection – though annoyingly only includes a cable for the latter. The screen itself has basic tilt adjustment, and a sleek if somewhat thick beveled look.

Verdict

Suitable for gaming and other uses, this bright monitor offers wide viewing angles at a great price.





\$250 | WWW.PHILIPS.COM.AU

23.8 inches; AH-IPS panel; 1,920 x 1,080 resolution; DisplayPort; DVI; VGA

Philips 241S6QYMB

A productivity monitor.

For those looking for a high-quality panel for work or home, the Philips 241S6QYMB has a lot to offer. Rather than a TN panel, the 23.8-inch monitor uses an AH-IPS panel, with wide 178° viewing angles. The Philips offers the usual 1,920 x 1,080 resolution, with a 60Hz refresh rate and 250cd/m2 brightness. The 5ms GTG response time is good enough to avoid ghosting during some casual play. The monitor also has a 1,000:1 contrast ratio, which boosts to 20 million to 1 using Philips SmartContrast.

The 241S6QYMB also has a fully ergonomic base offering height (110mm down to almost desk level), swivel, tilt and rotation adjustments.

We found the panel needed some minor colour adjustments out of the box, but overall gives a vibrant image with very even backlighting. The inbuilt speakers are a little tinny, but no more so than the competition. The 241S6QYMB has DisplayPort, DVI and VGA inputs, but no HDMI.

Verdict

While not aimed at gamers, this monitor wins points with its ergonomic stand and wide viewing angles.



\$290 | WWW.SAMSUNG.COM/AU

23.5-inches; VA curved panel; 1,920 x 1,080 resolution; HDMI; VGA

Samsung LC24F390FHE

Is it time for a curved upgrade?

Just scraping in under the \$300 limit if you shop around, the LC24F390 offers a curved screen experience. The panel is 23.5 inches wide, and uses the standard 16:9 aspect ratio. It also has a full HD 1,920 x 1,080 resolution, and uses a high-quality VA panel. This gives wider than TN viewing angles, as well as a higher-than-average 3000:1 native contrast ratio. Despite not being aimed at gamers, the 5ms GTG response time is pretty decent, and the screen supports AMD FreeSync.

In use, the 19° curvature of the Samsung screen makes it look larger than it actually is, but not to any huge degree. It takes a little getting used to, but helps it feel slightly more immersive, and easier on the eyes. The actual image quality is top notch, with deep blacks and bright colours. The Samsung has HDMI and VGA inputs, but no DisplayPort.

For those who want a smaller screen, the monitor also has a 21.5-inch version for \$250, or a 27-inch for \$430.

Verdict

Providing a decent gaming experience, this curved screen provides great image quality and colours, but won't break the bank.



\$170 | WWW.VIEWSONIC.COM.AU

24-inches; TN panel; 1,920 x 1,080 resolution; HDMI; DisplayPort; VGA

ViewSonic VX2457-mhd

Budget AMD gamers rejoice.

For those wanting a better-than-basic gaming experience for as few coins as possible, the ViewSonic VX series is a must-see. It comes in three sizes – the 22-inch VX2257-mhd (\$169), 24-inch VX2457-mhd (also \$169) and the larger 27-inch VX2757-mhd for just \$249.

The VX screens come with 1,920 x 1,080 resolutions and a TN panel. But going beyond the nice low 1ms response time, it includes FreeSync support and has a 75Hz refresh rate. The tech operates from 47-75Hz – well suited to mid-range AMD cards, providing a buttery smooth gaming experience, but not super high frame rates. It responds well to some OSD tweaks, but considering the price and spec, offers quite decent image quality and a uniform backlight.

In testing, FreeSync did an excellent job of eliminating stuttering and tearing. The VX2457-mhd has HDMI, DisplayPort and VGA inputs, but no DisplayPort cable, which is needed to actually use FreeSync.

Verdict

While the lack of DisplayPort cable is a frustrating caveat, this monitor delivers where it counts.



feature » windows 10 creators update



Windows 10 Creators Update: all the best bits explained

The second major update to Windows 10 has just dropped.

Matt Hanson tells you all you need to know.

When Windows 10 launched in July 2015, it was met with acclaim – and also a fair amount of relief – because it was a marked improvement over its predecessor, Windows 8. However, it still wasn't a perfect operating system, and Microsoft appears to have acknowledged this by releasing two major updates for it: The first, the Anniversary Update, hit our PCs last year, and now the Creators Update is currently rolling out to PCs around the world as you read this.

Windows updates are rarely worth getting excited about, but the number of tweaks, fixes and new features that Microsoft has promised with this release makes it worth downloading. As the name suggests, Microsoft has focused on bolstering the creative aspects of Windows 10. However, if you have less creative juice flowing through you than a heap of rocks, the good news is that Microsoft has a rather liberal interpretation of what it means to be a 'Creator'.

So it's not just people who like to put stylus to Surface and create digital art – it also applies to people who play games and like to stream and share their gameplay with friends and strangers across the internet. Of course, there is also the usual array of less glamorous (and arguably more essential) security and usability tweaks to make Windows 10 an all-around better piece of software to use.

In this article, we're looking at how you can download and install the Creators Update, why you would want to, what cool new features you'll be getting and how to use them. Windows 10 still isn't perfect, but with major free updates, such as the Creators Update, it shows that Microsoft is committed to evolving and improving its operating system, which is definitely something worth celebrating.

feature » windows 10 creators update

GET THE CREATORS UPDATE

The Windows 10 Creators Update is a free download for every Windows 10 user. The good news is that this means, at some point in the future, your PC will let you know that the update is ready to be downloaded and installed. All you need to do is make sure your work (or any game progress) is saved, then let Windows Update do its thing.

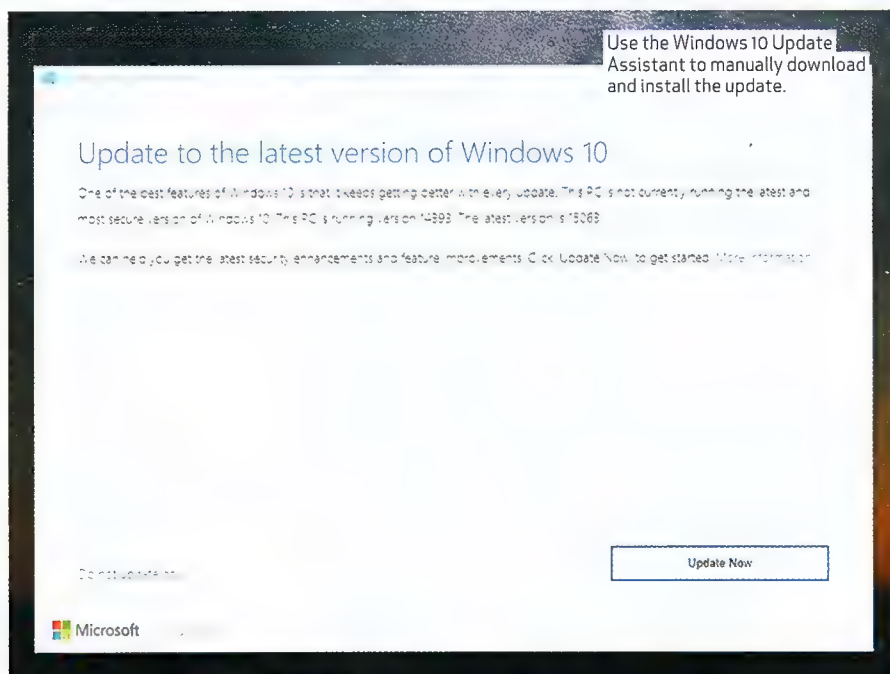
However, to stop the millions of Windows 10 users all trying to download the rather hefty update all at once, and potentially breaking part of the internet, Microsoft is rolling out the update to PCs around the world in waves, and it's been a bit coy about how long this rollout process will take.

So you might get the Creators Update in the next few days, or you may have to wait weeks – even months – before it appears in Windows Update.

However, like the Good News Fairy that we are (think the Tooth Fairy, but with a beer belly and faded *Half-Life 2* T-shirt), we have more glad tidings: there's a way to manually update to the Creators Update yourself, so you don't have to wait for the rollout.

To manually download Windows 10 Creators Update, head to the Windows 10 Update Assistant web page (www.microsoft.com/en-us/software-download/windows10), then click 'Update now'.

The tool downloads, then checks for the latest version of Windows 10,



which includes the Creators Update. Once downloaded, run it, then select 'Update Now'. The tool does the rest for you. Your PC restarts a few times – so make sure you save your work first – and then your PC is updated with the Creators Update, while all your files and settings remain where they were.

That website also allows you to download an ISO image, which you

can then use to update your current installation of Windows 10, or perform a clean install with the new Creators Update.

WHAT'S NEW?

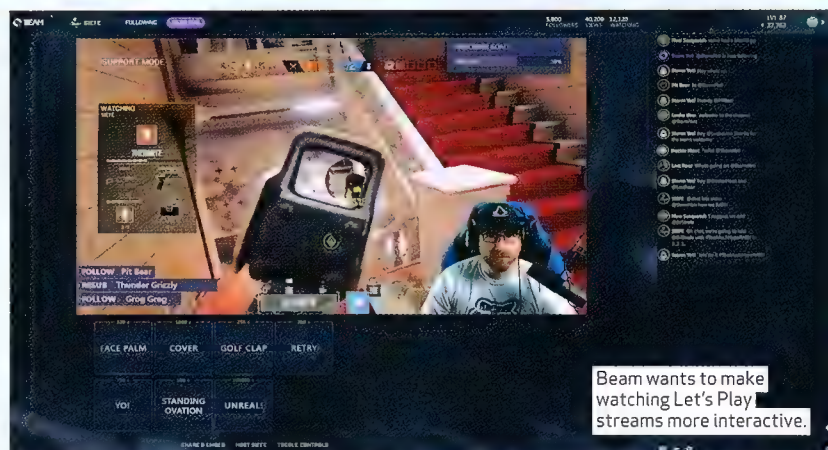
With the update installed, what new features await you? Well, one of the most exciting additions is a new program called 3D Paint. We know

Beam: Tools for broadcasting

Video game streaming is incredibly popular, with Twitch gaining 100 million monthly unique users watching over 2 million monthly streamers since it launched in 2011, with around 241 billion minutes of content being broadcast, so it's little wonder that Microsoft is so keen to get involved. It has done this by acquiring the Beam service last year, and integrating it into Windows 10's Creators Update and the Xbox One. Classic Microsoft.

Of course, with the success of Twitch and other established services, Microsoft has an uphill struggle to convince people to move from their preferred service to Beam. However, it has a few tricks up its sleeve.

For a start, it has a focus on super low latency, something Microsoft is describing as the "Beam Faster than Light SDK", which allows for broadcasting with virtually no latency. By having almost no perceptible pause between the action in the game, the broadcaster is playing and what the audience sees, it makes conversations

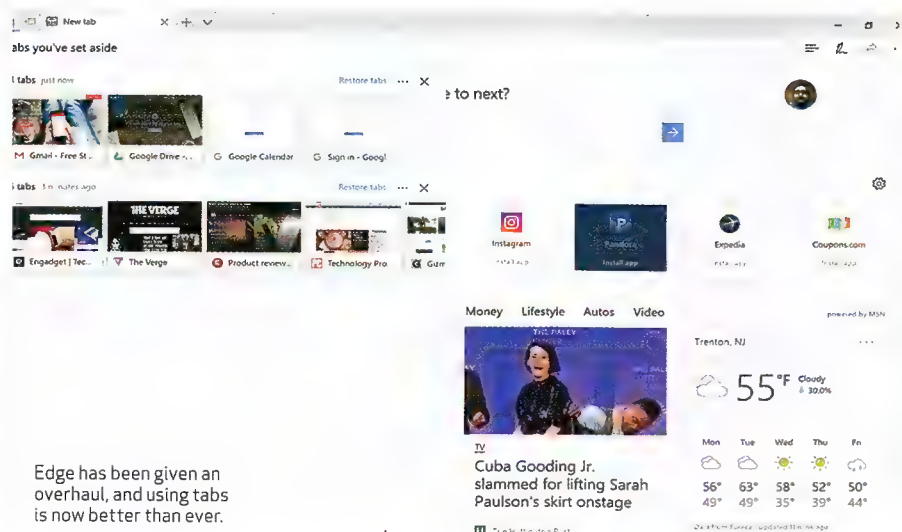


between the broadcaster and the audience even better. You could now tell a broadcaster to look out behind them, and they'd react, rather than telling them, only to find out three seconds later that they are already dead.

Microsoft also plans for Beam to have a full suite of interactive elements for its streams. These range from simple soundboard apps (which allow viewers to trigger specific sound effects) that can be applied to any game, through to

more complex interactive elements, introduced as part of Microsoft's 'Interactive 2.0' initiative, launched at GDC earlier this year.

When implemented into a game, these features (combined with the low latency) will enable viewers to be almost as involved in the action as the streamers themselves, "blurring the lines between playing and watching", as Microsoft puts it.



Edge has been given an overhaul, and using tabs is now better than ever.

what you're thinking: who cares about a new version of Microsoft Paint? And who still cares about 3D? We were as surprised as you are, after meeting Microsoft to see Creators Update before it launched, to come away so impressed by this new app.

3D Paint, like its 2D counterpart (which remains its own separate program), grants simple tools for people to create their own artwork. What's particularly impressive about 3D Paint is that the concept of creating models in a 3D space can be quite complicated, but 3D Paint makes the process incredibly simple, with the tools it offers appearing very straightforward at first, but powerful enough to create some impressive 3D works once you're comfortable using them.

These creations can be exported and viewed on normal PCs, or added to VR and AR applications to be viewed in 3D. Plus, if you have a 3D printer hooked up to your PC, it's incredibly easy to print off your creations. It's difficult to explain in writing, but trust us: load up 3D Paint and have a play around — it may just be your new favourite application.

Microsoft's renewed love of 3D extends beyond 3D Paint to PowerPoint (for 3D models and 3D animations, to make presentations slightly less dull), and the default Edge web browser, which now supports 3D content, and plays nicely with 3D files exported from various programs, such as *Minecraft*, *SketchUp* and, of course, 3D Paint.

While 3D displays are now out of vogue, mixed reality — just like virtual and augmented reality — is the hot new thing, and it is these technologies that have rekindled Microsoft's 3D passion. Under the name 'Windows Mixed Reality', which used to be called 'Windows Holographic', this is a mixed reality platform built by Microsoft

on the Windows 10 API, and it is now heavily integrated into the Windows 10 Creators Update.

It means that you can create your own 3D model (or simply download an existing one), and then easily place it into a real or virtual world using a VR or AR headset. While Microsoft's own AR headset HoloLens is a pricey proposition, Microsoft also announced last year that it is working with a number of headset manufacturers to bring third-party AR and VR headsets to Windows 10 machines. A new app, the Mixed Reality Portal, is included with the Creators Update to show you exactly what Windows 10 is capable of.

A FOCUS ON GAMES

Microsoft promising that it still cares about PC gaming, while chasing the shiny Xbox bauble, is something that a lot of us have heard many times before. At least with the Creators Update, it seems like Microsoft may be making some positive moves.

In the Windows 10 Settings app, there is a new addition: Gaming. This setting enables you to control many aspects of how Windows 10 handles games. Its most talked-about feature is the new Game Mode option, which helps your PC maintain solid frame rates as you play, while other background tasks and applications run. We go into more detail in the boxout on the right, but you can turn the feature on and off from the Gaming settings page.

The Game DVR settings page enables you to control how you take screenshots and record gameplay videos. While there's a number of programs that enable you to record and share videos, such as Nvidia's ShadowPlay, Microsoft hopes that, by baking this functionality into Windows 10, you're more likely to use its offering, especially as it's so easy to configure and begin recording.



Game Mode: Too good to be true?

Game Mode is perhaps the feature that generated the most amount of buzz ahead of the launch of the Creators Update. So much so that Microsoft actually had to downplay expectations, worried that people were getting their hopes up too high.

So what is Game Mode? It can be toggled from the Game Bar (Windows-G on your keyboard brings this up), and it tells your system to reallocate CPU and GPU hardware resources to prioritise the game at hand when it's the active, full-screen application.

The results, as Microsoft claims, are steadier frame rates than before, notably with games that particularly tax a given system's resources. The idea is that if you're playing a game and recording it in the background — or you have another intensive task running while you play — Game Mode tells Windows 10 to prioritise your game, so you don't see major dips in frame rates. Unlike what some people were hoping — that Game Mode would strip down background apps and tasks while you're playing, to give you hefty boosts to FPS — Microsoft was keen to stress that the results are about stabilising frame rates, not boosting them. Microsoft also warns that Game Mode brings the most benefit to systems that aren't absolutely optimised for gaming, so if you have an all-powerful rig packed with Titan Xp GPUs, you won't see much difference.

Both Universal Windows Platform (UWP) and Win32 games support Game Mode. Microsoft keeps an internal list of games for this feature, and others related to gaming, which we're told is updated more frequently than Windows itself.

There's no word on how many games — Win32 or UWP — support the feature, but we get the impression that the number is enormous. A select, growing number of games — regardless of whether they're UWP or Win32 — will see the feature automatically enabled. Of course, disabling Game Mode on a game is as easy as enabling it.

Paint 3D: Getting Creative

As we mentioned earlier, Paint 3D is genuinely one of the most impressive additions included with the Creators Update. When seeing it first-hand, creating three-dimensional pieces of art truly is as simple as Microsoft demonstrated at the update's reveal event last year.

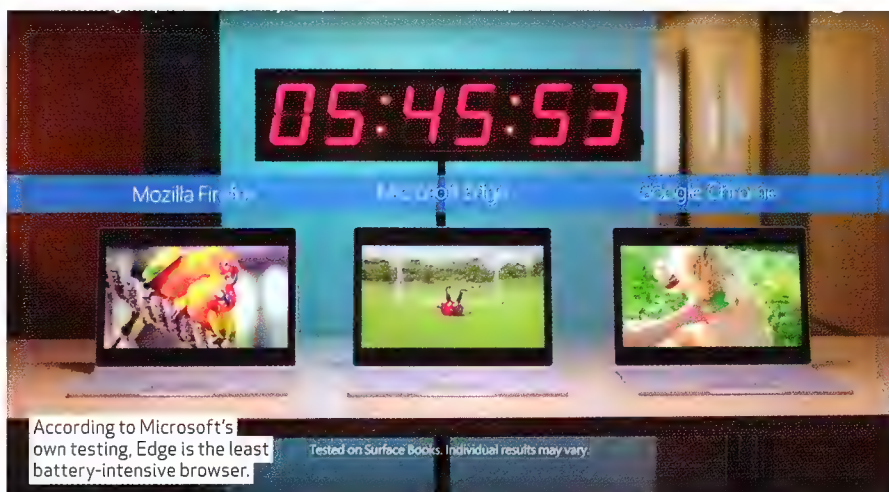
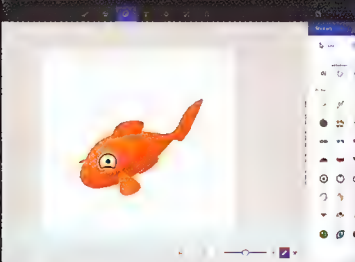
Then again, it's clear that this app has the capacity to allow for quite a bit of complexity, too. Most of that simplicity comes down to how intuitively the app communicates three dimensions in a two-dimensional space. Clever, minimalist use of sliders and other toggles enables you to shift your creation's position on either axis.

Of course, a wide selection of pre-loaded creation templates — such as goldfish — will help newcomers out immensely. Naturally, it wouldn't be Paint without the ability to freehand in 3D, and thus comes the desire to share those custom creations. That's where Remix.com, Microsoft's online portal for sharing these Paint 3D projects, comes into play.

The way in which Paint 3D communicates how to create in a new dimension so easily for the average user, yet offers the depth to please them as they increase in skill, could do a lot of good for the 3D printing scene, as well as VR, and so many other fields further down the road — such as being able to add our creations to games.

Granted, Paint 3D is by no means a professional-grade 3D modeling app — this is purely meant for the vast majority of Windows 10 users who would just like to dabble. You can also export anything created in Paint 3D as 3D-ready FBX or 3MF files for 3D printers.

Regardless, we're already impressed with what Paint 3D can do, and only hope it grows from here. Oh, and don't worry, the old Paint remains untouched.



Microsoft also argues that, by using Windows 10 to record your gameplay, rather than third-party software, your PC will have more resources at its disposal, which, in turn, should give you more consistent and stable frame rates when you play games while recording.

Among the new Game DVR settings is the ability to turn audio recording on (and off), if you want to provide narration, and you can choose the frame rates and video quality from here as well.

You can also set Windows 10's Broadcast settings from this window. In the Creators Update, Microsoft is looking to seriously up the reach of, and community around, games played on Windows 10 with a new feature called Beam. An acquisition recently made by the firm, Beam is a PC game streaming and broadcasting platform, similar to Twitch, replete with its own streaming network via web browser, converted into a baked-in Game Bar feature (which can be brought up by pressing Windows-G on your keyboard).

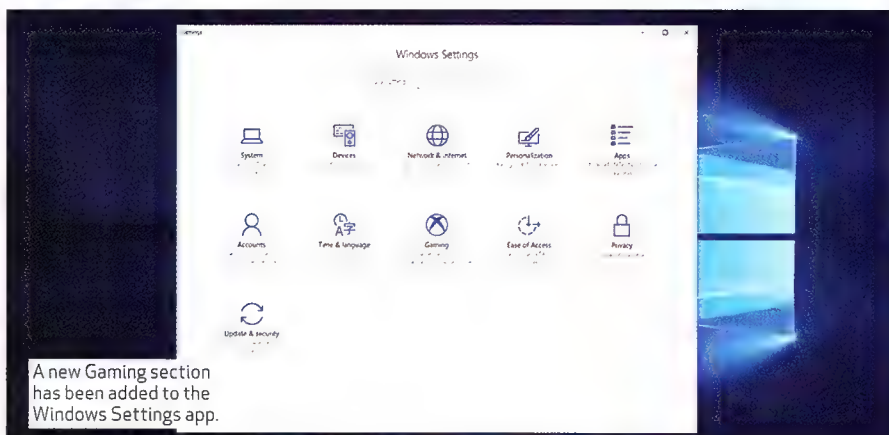
Beam's major claim to fame here, though, is that it maintains sub-second latency from the broadcaster's executions in-game to those moments being displayed on your PC screen

via stream. In other words, for broadcasters, this reduction in the time between what you're doing in-game and your viewers seeing it makes interacting that much more interesting.

Broadcasting via Beam is made incredibly simple in the Creators Update — all you need to do is open up the Game Bar, click the Broadcast icon, then just a few clicks and toggles later, you're broadcasting to Beam viewers worldwide. That's after creating a Beam account, as well as an Xbox Live account, if you haven't already. Once again, this is a sign that, as good as the new features ushered in by the Creators Update are, many of them require you to be fully signed up to Microsoft's ecosystem. If you're not too keen on Microsoft's recent direction, you may not be a huge fan of this. It is, after all, also doubling down on the Windows Store and UWP (Universal Windows Platform) apps for games.

OTHER FEATURES

There's a load of other features included in the Creators Update, and while they aren't as headline-grabbing as Game Mode and mixed reality support, their addition definitely makes Windows 10 a much better operating system.



A new Gaming section has been added to the Windows Settings app.

Take Night Light, for example. It's Microsoft's answer to Night Shift on macOS Sierra, and it is an effective and welcome feature for people who tend to use computers at all hours of the night. It lowers the amount of blue light your PC emits through its display, which can play havoc with your internal clock.

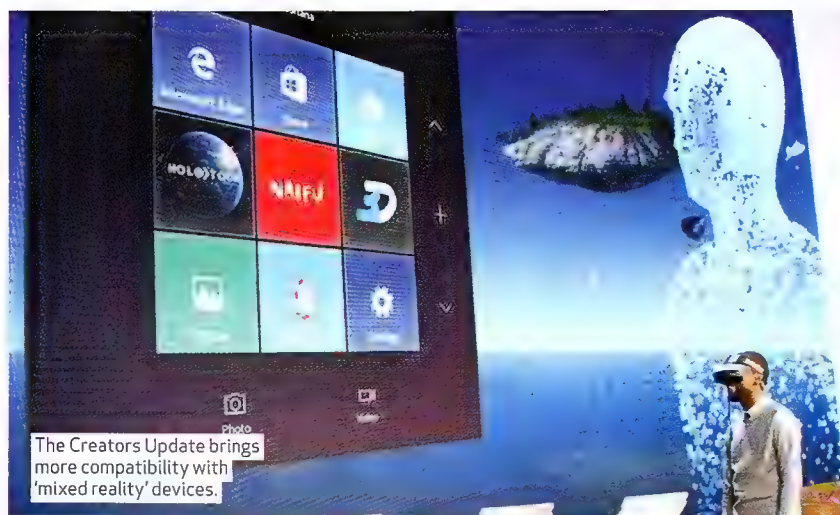
Even better, Night Light enables you to adjust the tone of the colour change, in addition to the standard setting of whether the mode kicks in at sunset local time or activates within set hours.

Microsoft has also thrown a lot of new features at its Edge browser in a bid to make us ditch Chrome and Firefox. As well as the aforementioned support for 3D media, it also includes a genuinely useful tab preview bar that gives you a visual overview of all your currently open tabs, so you can quickly and easily switch between the ones you need. This is a great addition for those of us who usually end a browsing session with an unwieldy number of tabs open. You can also 'set tabs aside', which is Microsoft speak for saving open tabs as a collection, which you can then open and restore later.

Edge has often felt a little neglected when it comes to add-ons and extensions, with popular ones on Firefox and Chrome often skipping Microsoft's latest browser. The company is looking to fix that with the Creators Update, by bringing a large number of popular add-ons and extensions to Edge.

Microsoft has also worked hard on making Edge as lightweight as possible, which means that if you're browsing the web on a laptop or tablet, Edge should be less taxing on your device's battery, which should mean more time before your machine dies.

To prove its point, Microsoft has released a battery test video comparison, showing the staying



power of the three most popular browsers side-by-side, pitting its own Edge offering against Google's Chrome and Mozilla's Firefox.

The test was a simple one: which browser could last the longest while streaming full-screen video from Vimeo. Given that Microsoft is keen for you to see the results, there's no prizes for guessing which browser came out on top — yep, Microsoft Edge.

Edge didn't just, well, *edge* the test either. Instead, it dominated proceedings, lasting a full 35% longer than Google Chrome, and a massive 77% longer than Firefox.

While Firefox lasted just 7 hours and 4 minutes before conking out, Chrome managed a full 9 hours and 17 minutes of streaming.

Microsoft's Edge browser, which has been specially tuned for the new Windows 10 Creators Update, just kept on chugging, eventually notching up 12 hours and 31 minutes of streaming time before finally calling it a day.

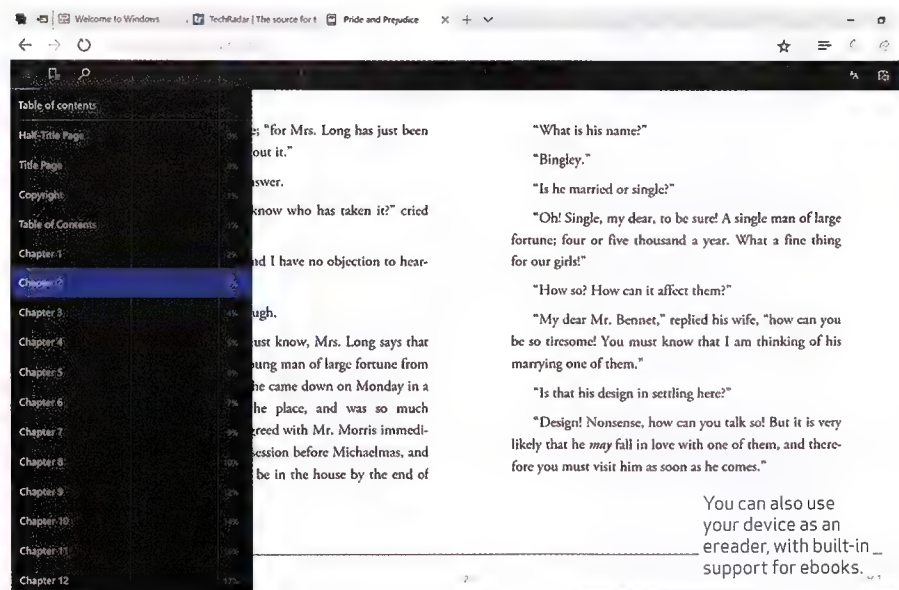
In terms of fairness, the three browsers were each made to run on identical Surface Book machines, each powered by Intel's 2.4GHz Core i5-6300U processor, 8GB of RAM and Intel HD Graphics 520 GPU. Ensuring further parity, each device was muted, had brightness set to 75%, Bluetooth and location disabled and the Quiet Hours functionality switched on.

To be honest, it's not quite enough for us to make the leap from our trusted browsers to Edge just yet, but it looks like it is definitely going in the right direction.

PRIVACY

As good as Windows 10 is, there were concerns around the default privacy settings it shipped with, with many people worried about the kind of data — and control — to which Microsoft has access. The company has been aware of these criticisms, and it has responded by trying to make it more transparent what kind of data it collects in the Creators Update — as well as making it easier for you to change any privacy setting you don't like.

When you update Windows 10 to the Creators Update, you'll see a screen asking you to choose the privacy settings of your device. The options are for Location, Diagnostics, Relevant Ads, Speech Recognition, and Tailored Experiences with Diagnostic Data. Each option has a 'Learn more' button that you should click to get a full explanation about what it affects. In our eyes, this is a very positive step that Microsoft has taken, and while we'd rather most of those settings were off by default, we're glad that Microsoft has explained each setting thoroughly, so that you are mostly in control of your privacy when using Windows 10 Creators Update. ■



how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

WINDOWS

MOVE APPS TO ANOTHER DRIVE

My Pavilion x360 laptop only has 32GB of onboard storage and I've run out of room. Is it possible to move apps across to a microSD card I've added to it?

John Craggs

Moving apps can be a tricky business — it's easier with Windows Store apps, but it can also be done (with care) with desktop programs, too. As always, take a full backup before embarking on this procedure — just in case — then follow these instructions:

1 To move Windows Store apps, click 'Start > Settings > System > Apps & features'. Sort the list by size to target the largest apps first. Click an app — if there's a 'Move' button, you can use this to move the app to your microSD card with a couple of clicks.

2 You can also force future Windows Store installs to go to your microSD card by default. Navigate to the Storage section and tap 'New apps will save to:' to select your microSD card. Note this doesn't affect traditional desktop programs.

3 If your internal storage and your microSD card are NTFS-formatted, you can move desktop apps without having to reinstall them. Download and extract Steam Mover

from www.traynier.com and right-click it and choose 'Run as administrator'.

4 Click '...' under 'Steam Apps Common Folder' and select C:\Program Files or C:\Program Files (x86). Click '...' under 'Alternative Folder' to select a folder on your microSD card. Now 'Ctrl-click' each app you want to move and click 'v' to move them.

Nick Peers

A Windows update should have fixed any issues users were having with Logitech webcam software.



"We're pleased to report that Microsoft has issued a fix for the problem."

HARDWARE

LOGITECH WEBCAM WON'T WORK

I recently installed an update to Windows 10, but now my Logitech C270 webcam won't work — whenever I attempt to launch the software, it crashes with an error message telling that 'Launcher_main.exe has stopped working'. I've tried uninstalling and reinstalling the driver software, but that doesn't seem to help.

William James

This problem actually arose after the Windows 10 Anniversary Update dropped support for certain types of compressed webcam streams (MJPG and H.264). However, since speaking to William, we're pleased to report that Microsoft has issued a fix for the problem.

Mayank Sharma

WINDOWS

SET UP PC FOR MULTI-PURPOSE COMPUTING

I have a long history of way too many programs being installed on my computers, and this obviously makes them particularly slow and buggy. In general, these programs fall into three or four categories: work, writing, graphics and play. I'm thinking of making an ISO file of the basic computer, then creating separate ISO files for each category of use, switching between them



Steam Mover

Have you run out of space on your C:\ drive?

Or do you have a super-fast SSD that is too small to hold all your steam games at the same time?

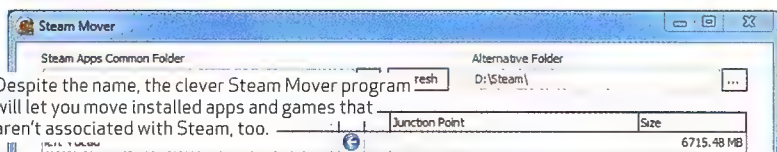
Then try Steam Mover.

Following on from a very interesting post on the Steam forums I've created a little app to make moving the files and creating the junctions easier!

Example Use

Here I have my steam folder in the default location, and the application should find that for you. If not, select the \Steam\SteamApp yourself, and a secondary hard disk D:\, where I have created a folder

Note that Steam Mover can be used to move any folder around (by changing the Source Path), but for Steam the maximum benefit games from the Common folder.



Despite the name, the clever Steam Mover program will let you move installed apps and games that aren't associated with Steam, too.



Investing in a low-cost SSD is an easy way to speed up an aging PC.

when necessary. Does that make any sense or is there something a lot better? What would you recommend doing?
Marshall Brown

We like the idea, Marshall, but it's not really that practical. It would involve either using drive images and switching between them, or setting up a complicated multi-boot system, with four separate Windows installs, each one focusing on a different category. Neither is a practical or guaranteed solution to your problems. What would work better is investing in boosting your PC's overall performance.

Double its RAM (8GB should be adequate even for demanding systems) and — crucially — invest in a fast 120GB SSD drive on which Windows and your programs can reside, keeping your existing drive as storage for data and other files. This twin performance boost should make your PC easily capable of handling your demands, without requiring any complicated setup.

Graham Barlow

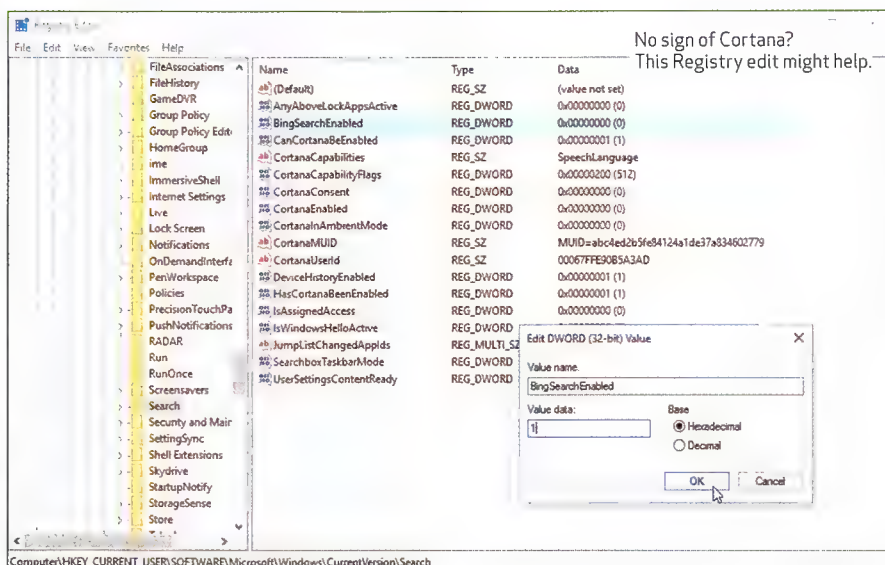
WINDOWS

CORTANA HAS STOPPED WORKING

I upgraded to the Anniversary Update, and now Cortana has disappeared from the Search bar — instead I can 'Search Windows', but nothing else. I've checked my language and region settings — all set to English (Australia). Help!
Mike Talbot

Press 'Windows-R', type `regedit` and hit Enter to open Registry Editor. Now browse to the following key: `HKEYCURRENTUSER\SOFTWARE\Microsoft\Windows\CurrentVersion\Search`. Check the `BingSearchEnabled` value in the right-hand pane — if it's set to 0, as it was in Mike's case, double-click it, change the value to 1 and click 'OK'. Cortana should immediately start to work when you next click the 'Search Windows' box.

Graham Barlow



MAC

MAC DASHBOARD NO LONGER LOADING WIDGETS

The Dashboard has suddenly stopped working properly on my iMac, although the same set of widgets installed on my MacBook Pro still works fine, and they also work in the other account on the iMac. Restarting the iMac in safe mode makes no difference, and I've tried repairing permissions and the startup disk without any joy. Any idea what's causing this, and how it can be fixed?

Simon Simpson

This is a sporadic problem that most commonly occurs when one or more installed widgets won't load properly, and blocks others from loading. The best way to tackle it is to uninstall your widgets, then add them back one at a time to find the culprit. Create a couple of folders in your user account's Documents folder to contain all your widgets during this process. Move everything from `/Library/Widgets` into one of them, and the contents of `~/Library/Widgets` into the other, then start to restore one at a time until you discover which causes the issue. If you can, immediately obtain an updated version or a fresh copy of any widget

that's problematic, then continue restoring the remaining widgets into their correct folders one at a time, in case more than one is at fault. Because this problem is confined to a single user, it's most likely to be an issue with a widget in `~/Library/Widgets` (the tilde, `~`, signifies the path to the logged-in account's folder). Sometimes just moving them all out and back again sorts out the problem.

Howard Oakley

SECURITY

REMOVE INFECTION BY RESETTING PC?

My wife's PC was successfully upgraded from Windows 7 to 10 last year, but I recently noticed that the Zeus virus had somehow slipped through her defences.

I was unable to eradicate it, so decided to perform a reset through Settings, but it freezes on the keyboard layout screen. Can you assist please?

Tony Morsani

Trying to eradicate any kind of infection through a Windows reinstall or reset is not particularly recommended, as some infections can survive this. It's far more advisable to treat the infection at its source, then



reconsider your position afterwards. Tony had been unable to download additional anti-malware tools because the infection kept redirecting him away from the sites he needed. We advised Tony to follow the advice in the security feature in *TechLife's* May 2016 issue for removing infections by downloading the recommended tools – including RKill and ADWCleaner from <https://toolslib.net> – to his own, clean PC. He then transferred them across via CD, which allowed him to clean the infection using a combination of these tools along with Malwarebytes Anti-Malware and NetAdapter (<https://sourceforge.net/projects/netadapter>). Cat Ellis

WINDOWS

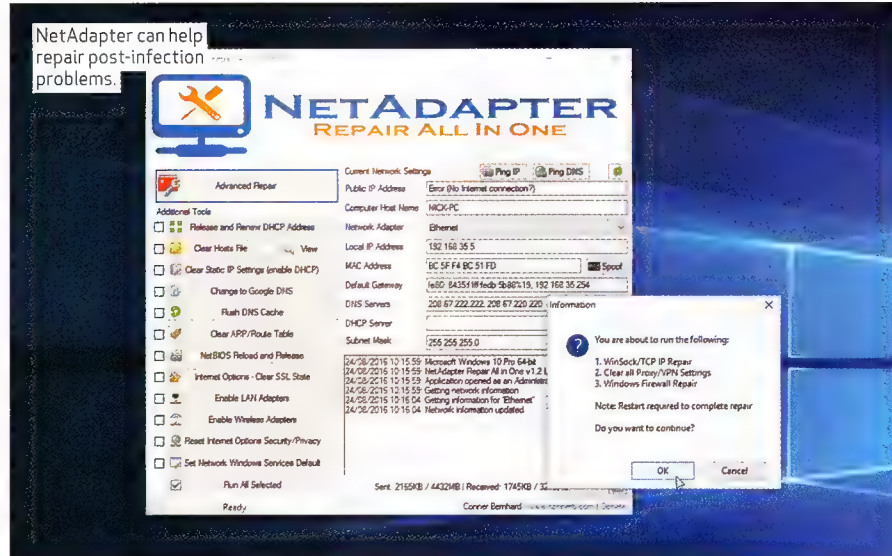
DUAL-BOOT CONUNDRUM

I'm running Windows 7 on my PC's main SSD drive, but prior to the upgrade offer ending, cloned the drive to another disk and upgraded that to Windows 10. However, if I want to boot into Windows 10, I have to disable the SSD drive in my PC's BIOS for it to boot. The local PC repair shop shrugged their shoulders and couldn't help — can you?

Jamie Marshall

We identified Jamie's PC has having an older nForce motherboard, with no option to choose a boot device when starting his PC. Newer PCs have an option to choose the drive to boot from, which he could have used to switch between the two. The problem is that Jamie made an exact clone of his original drive, so the second drive has its own bootable partition, and neither drive's bootable partition knows the other version of Windows exists. As the SSD drive is the current default for your PC, boot into Windows 7 from that. Next, take an updated drive image using Macrium Reflect (www.macrium.com/reflectfree.aspx) – just in case.

Now go to www.boyans.net/DualBootRepair.html to download the



recommended tool for fixing your dual-boot problem – you need to select the Dual-boot Repair Tool 10 link. Save the zip file to your hard drive, then extract its contents and run DualBootRepair.exe. Choose 'Automatic Repair'. You should see both versions of Windows are detected. Click 'OK' followed by 'Run' and the repair should be performed. You can verify this by clicking 'Start > Run', typing `msconfig` and hitting Enter, then switching to the Boot tab. You should see two entries, with the Windows 10 entry set as the default (change this to Windows 7 by selecting it and clicking 'Set as default'). Reboot and the fix should be complete.

Matt Hanson

STREAMING MEDIA

APPLE MUSIC DOWNLOAD PROBLEMS

I am writing to see if you've ever encountered any issues with Apple Music and the ability to sync songs for offline playback.

I have a free subscription through Telstra and decided to use it on my old Sony Xperia Z3. I put in a 128GB micro SD and

proceeded to download everything I could. However, some albums and songs wouldn't download.

I went through hours of troubleshooting with both Apple and Sony. I did everything they suggested but some albums and songs will still not download. Any ideas?

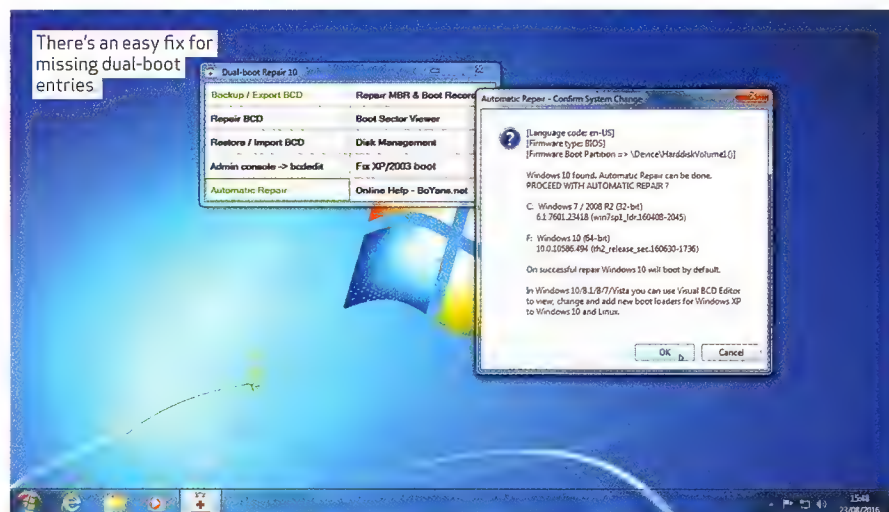
Benjamin Rae

We spent a bit of time looking into Benjamin's problem and it seems to be a reasonably common occurrence – and one that's actually related to the Telstra-based Apple Music subscription offer that happens on both Android and iOS devices. Sadly, there's no real clear-cut solution, despite it seemingly having been a known issue for over a year. Taking a look on Telstra's Crowd Support forums (tinyurl.com/tla60-forum), there are many Telstra customers complaining of similar problems with offline music downloads, but no certain fixes.

More pertinently, according to the most recent user post at the time we were researching this issue, it sounds like Telstra has given up trying to fix the problem, and is now just stating that "Make Available Offline is not provided with the trial subscription. Only streaming is allowed with the subscription." Some users claim to have been able to get some compensation by lodging a complaint with the TIO, based on the fact that the free Apple Music subscription hasn't worked as implied (tinyurl.com/tla60-tio).

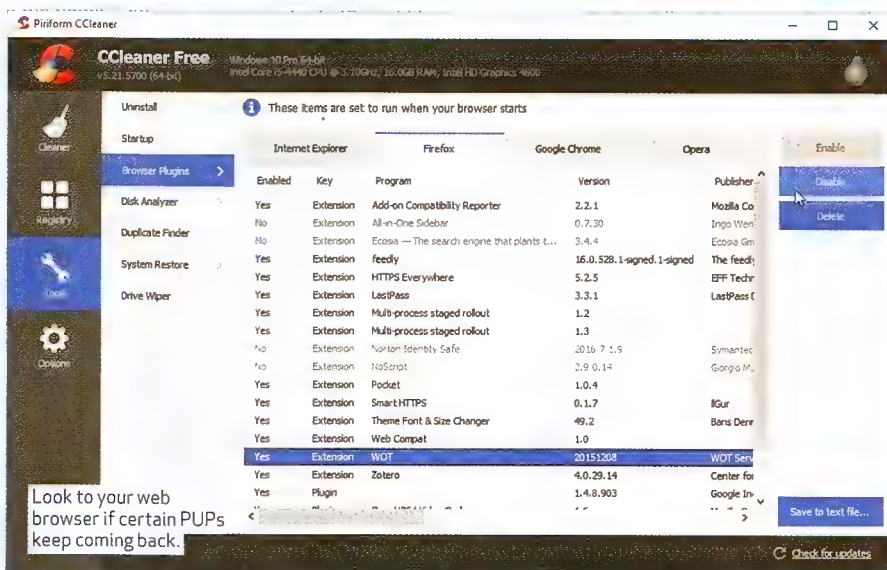
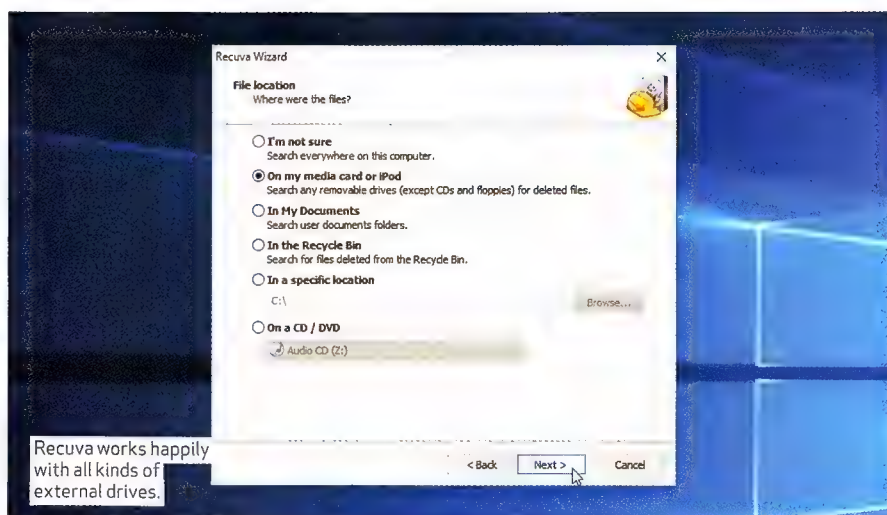
If you're a Telstra customer with this problem and none of the other suggested fixes in the above forum thread help, we'd also suggest going down the TIO route and then, if desired, you can use the compensation to purchase a streaming-subscription directly from your preferred supplier... be that from Apple Music, Spotify or someone else.

Dan Gardiner





The inability to download certain Apple Music songs with Telstra's free trial offer seems to be affecting quite a few users.



"Your chances of recovery are high, and you can view many file types before restoring them, too."

STORAGE HOW CAN I VIEW DELETED SD CARD FILES?

I accidentally deleted one file on my working SD card — everything else is okay. I googled for software that could view deleted files, but everything I find relates to recovery software. Do you know of any programs that can view deleted SD card files?

Ken Olson

You can view (and restore) deleted files using specialised recovery software. Our sister publication TechRadar rounded up six of these at www.techradar.com/1321723, but we'd specifically point you towards Recuva (www.piriform.com/recuva) from that round-up as one of the simplest to use. As long as you've not written any data to the SD card since deleting the

file, your chances of recovery are high, and you can view many file types before restoring them, too.

Cat Ellis

SECURITY CAN'T REMOVE PUP INFECTION

I've scanned my system several times with Malwarebytes Anti-Malware and it keeps reporting the same PUPs, despite the fact I keep cleaning them out. How do I get rid of them?

Jim Duncan

PUPs can be a tricky form of malware to remove, particularly if they originate from the web. In Jim's case, Malwarebytes would successfully shift them, but they'd come back a while later. He was able to identify the infection as 'PUP.Optional.Mindspark.Generic', which is a generic term that

can apply to a wide range of infections. Later, Jim was able to confirm which files had been infected, all of which were residing inside the Firefox cache folder, confirming their origin. We instructed Jim to list all his browser add-ons — one in particular stood out, called Security Plus, which has privacy issues associated with it. We then pointed Jim to CCleaner (www.piriform.com) — first, to disable all browser extensions via the 'Tools > Browser Plugins' tab, and then to clear out the entire Firefox cache via the Cleaner button's 'Applications' section (right-click the Firefox entry and choose 'Analyse' followed by 'Run Cleaner' to clean out Firefox without affecting other settings).

This did the trick, but we wouldn't be surprised to see the infection return as Jim browses the web, in which case a more pro-active solution may be required — the Professional version of Malwarebytes offers real-time protection, which should keep these at bay, for example.

Nick Odantzis

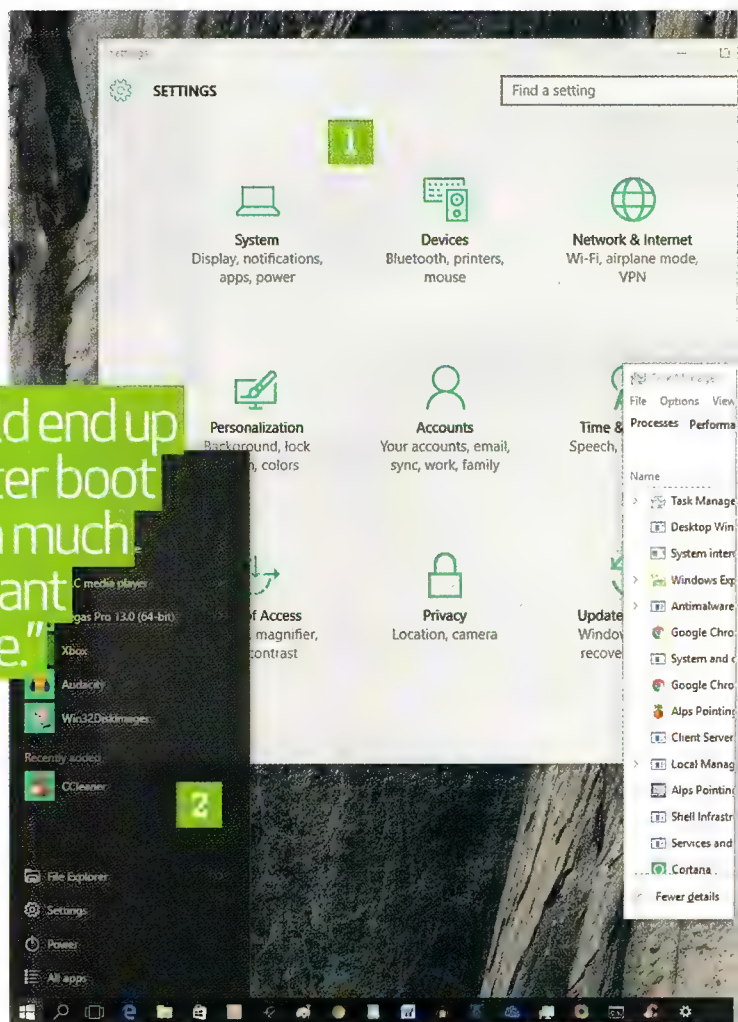
Learn how to streamline Windows 10

With just a little effort, you can make Windows 10 slicker, faster and easier to use with Alex Cox.

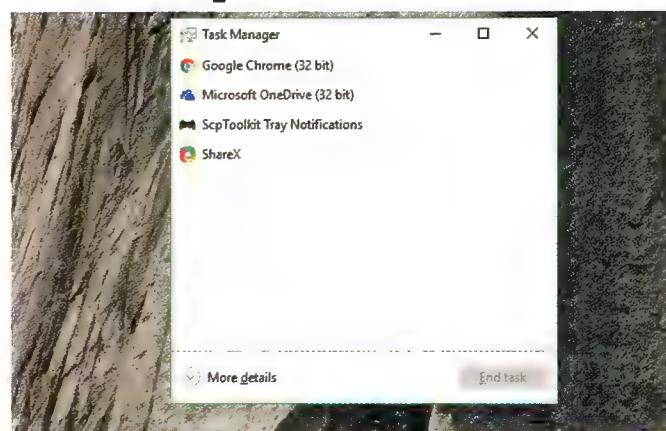
Not all computers fare particularly well in their transition to Windows 10. The promised quick, clean environment and super-fast boot time might not have materialised. Or there might be as much clutter as there was before, if not more. And for the majority who have had a pleasant Windows 10 experience, you could make it even better still.

Here, we'll speed up your system and clean it up at the same time. We'll also disable some of Windows 10's less essential features, clear away unwanted clutter, and make sure you're only running the programs you need at startup. You should end up with a faster boot time and a much more elegant experience. And since most of the things we're going to do are non-destructive, you'll be able to switch back the changes at any time if you miss certain features.

"You should end up with a faster boot time and a much more elegant experience."

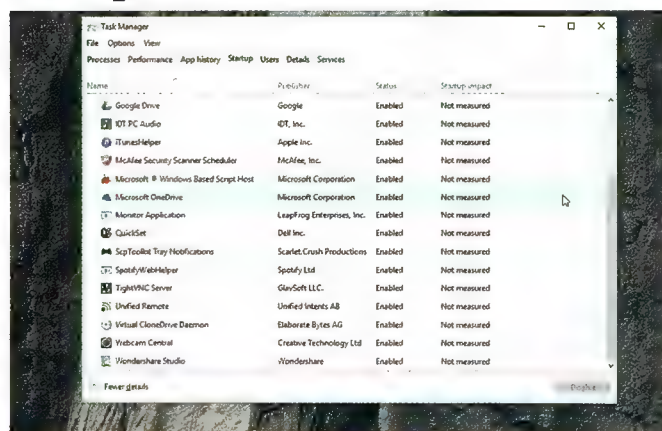


Clean your Windows 10 system



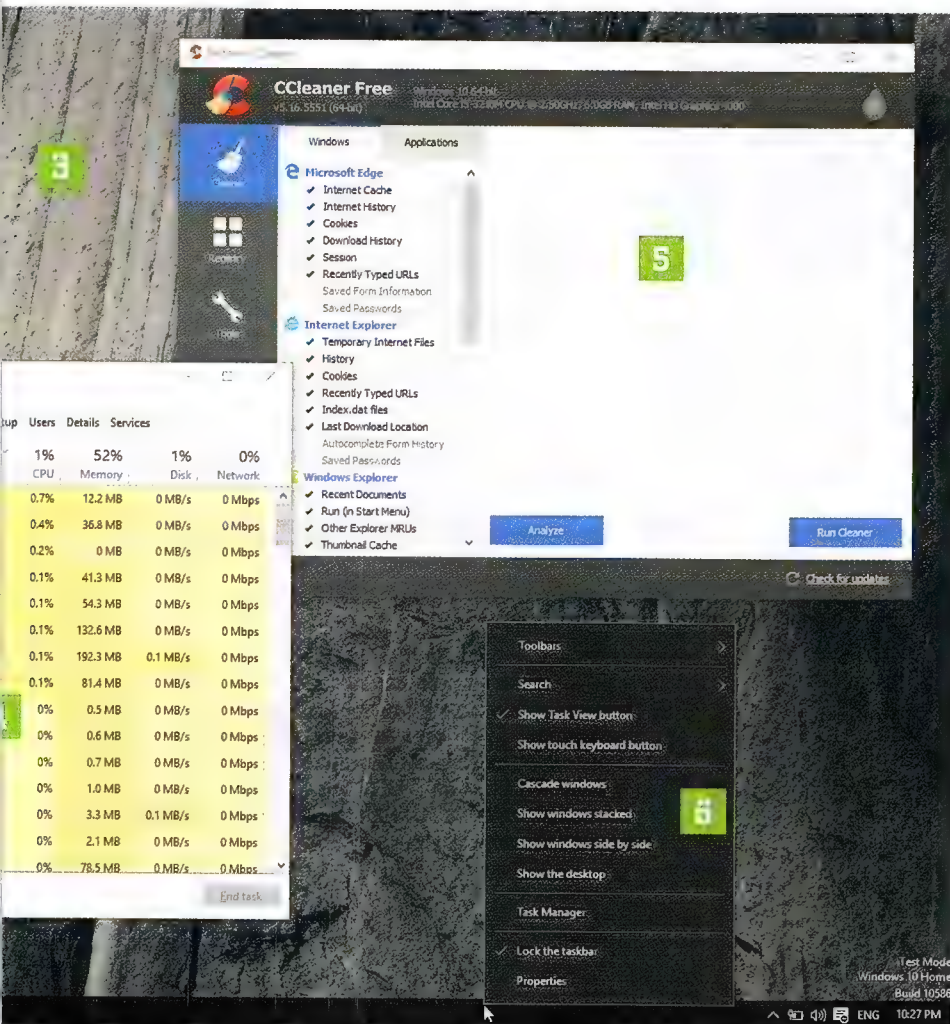
1 START ATTACK

If you've upgraded to Windows 10 or picked up a new PC with it pre-installed, it's likely that a number of existing programs will run at startup. Each one of these takes time to load, contributing to that laboured power on sequence. Hit Ctrl-Shift-Esc to open Task Manager, click the arrow to see more information, then click the Startup tab to see the offenders.



2 CHOOSE YOUR VICTIMS

You'll see a list of programs, the majority of which you've probably never used. So with the exception of your anti-virus software, you're safe to disable as many as you like. Reboot your machine, and you should notice the difference. If you disable something then find you need it, head back to Task Manager to switch it back on again.



1 SETTINGS

Many of Windows 10's newer, more vocal features can be disabled by digging through the Settings application.

2 START MENU

Tidying up your Start menu might take a while, but it's well worth the effort when it looks this neat.

3 NO ICONS

Hiding your desktop icons means you can keep your mind on what you're doing and get a less cluttered look.

4 TASK MANAGER

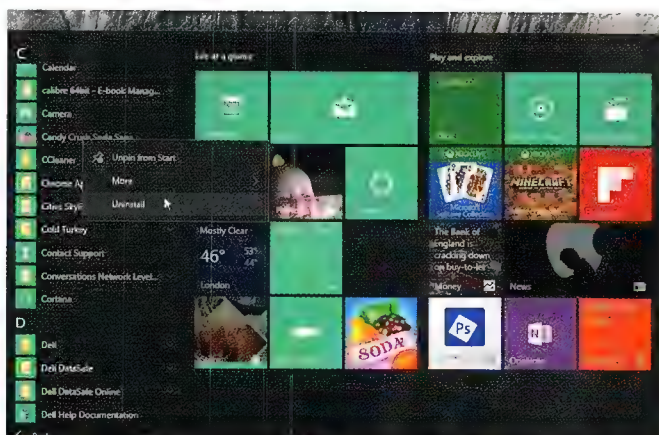
Task Manager is a great way to see which programs are bogging your PC down and, in the Startup tab, stop them running automatically.

5 CCLEANER

Sometimes, special measures are required. CCleaner can do away with certain things that Windows would rather have you keep.

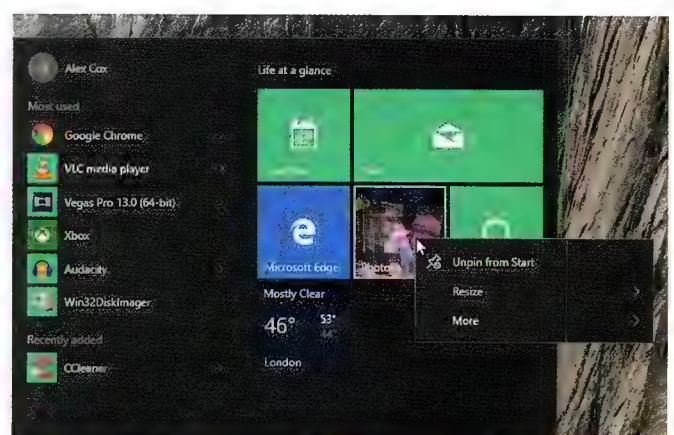
6 TASKBAR SETTINGS

Gain extra screen space with a smaller taskbar and do away with that ugly search box using its right-click menu.



3 QUICK UNINSTALLATION

While we're dealing with software, let's clean away some unloved applications. Windows 10 makes this easier than ever. Any application you've installed can be removed by finding it in the Start Menu's 'All Apps' list, right clicking, then clicking Uninstall. Sadly, this won't work for Microsoft's pre-installed applications, however infrequently you might use them.



4 MENU MASSACRE

Let's look at the Start Menu more closely, as it's ripe for a little streamlining. The Live Tiles on the right side won't all be to your taste and, in fact, you can get rid of them altogether, although it'll take a little time. Right-click each one, and select 'Unpin from Start' until they're all gone. This will reduce your Start Menu to a single column.



The gigantic search

APPENDIX 1

☐ PCs on my local network



Now let's search for a little



1875

6. Reform CGU



Our final bit of house-c-

10

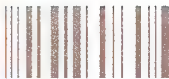
In CCleaner's to

74 www.apcmag.com



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Get to grips with iOS 10.3

Discover new and improved features for your iPhone or iPad with Alan Stonebridge.

The latest system update for your iPhone and iPad might sound like it's a minor one, but you'll find useful tweaks in it that enhance how you use your iOS device. One very welcome change is you can now simply delete unwanted event invitations and report them as junk to Apple.

Siri integrates better with ride booking services by enabling you to schedule a pickup for a specific time, rather than immediately.

Also, if you have a payment app that supports Siri, you can now use your

voice to check the status of bills and pay them.

Movie rentals have become more flexible, with the ability to initiate them from your Mac, iOS device or Apple TV, and switch to another device to watch them.

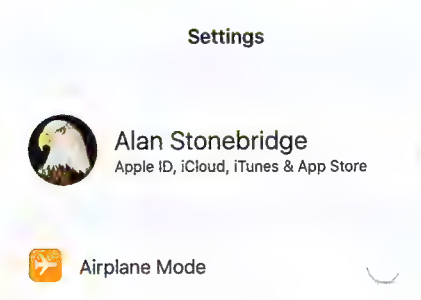
The Home app now enables you to trigger scenes from switches and buttons, and shows accessories' battery level and charging status.

While these changes are handy, we think you'll use those described in the following walkthrough more often.

"If you have a payment app that supports Siri, you can now use your voice to check the status of bills and pay them."

How to

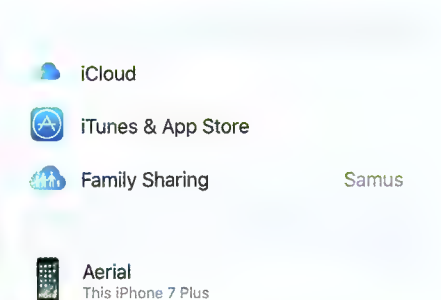
Manage your Apple ID and related services



1 YOUR APPLE ID
Settings for your Apple ID and services that use it — iCloud, the iTunes Store and the App Store — have been consolidated in a bunch of pages that are reached by tapping your name at the top level of Settings.



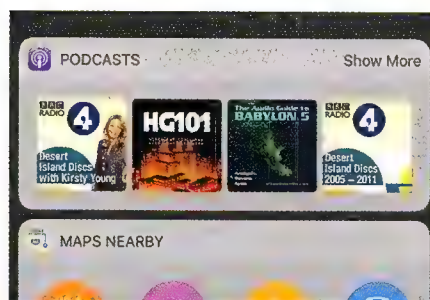
2 PERSONAL DETAILS
The first three items enable you to change your contact details on file with Apple, the password and other security settings for your Apple ID, and your payment method details for use by Family Sharing (apple.co/2o42grz).



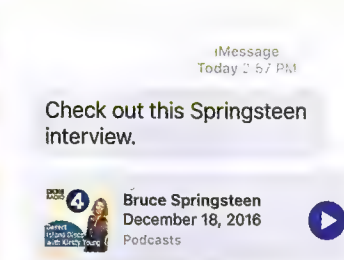
3 ICLOUD AND MORE
Next are your device's iCloud, iTunes/ App Store and Family Sharing settings, then devices using your Apple ID; tap a device to check its serial number or tracking status, or to remove Apple Pay authorisation from the device.

How to

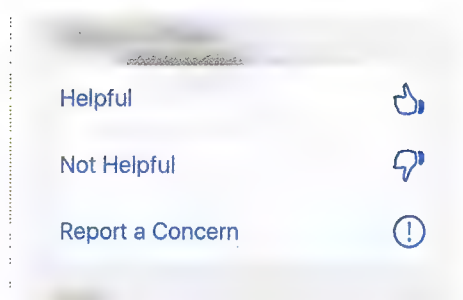
Better control Apple's media and store apps



1 THE NEW PODCASTS WIDGET
Swipe right on the first Home screen, scroll all the way down and tap edit, then add the Podcasts widget. The widget shows podcasts with unplayed episodes; tap the artwork of one to catch up with the oldest of those episodes.



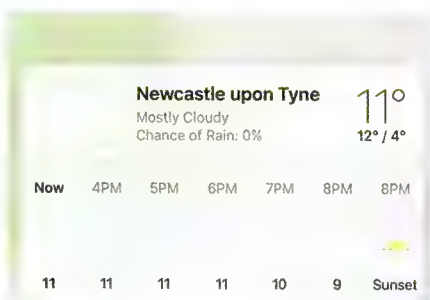
2 SHARE PODCAST EPISODES
A small but nice convenience is that episodes shared using iMessage no longer display a link that'll take you out of the Messages app; instead, you can initiate playback right from your chat, rather than jumping out to Podcasts.



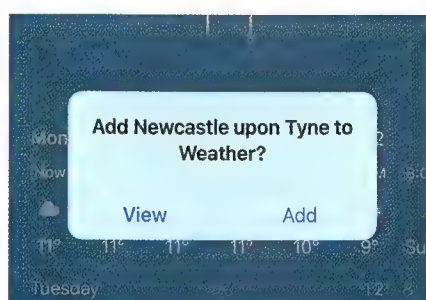
3 REACT TO APP REVIEWS
In the App Store, apply a long press or 3D Touch to someone's review to rate its helpfulness or, importantly, draw Apple's attention to questionable behaviour. This doesn't work for iTunes Store, iBooks Store or podcast reviews.

How to

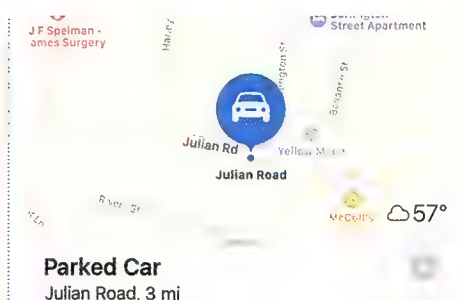
Use new location-based features



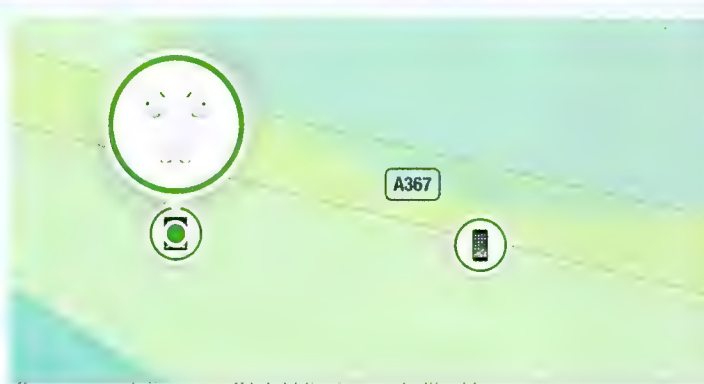
1 WEATHER IN MAPS
iOS 10 already showed the current weather and temperature for the area you're viewing in Maps (if zoomed in far enough). In 10.3, on a device with 3D Touch, press lightly on it to get an hourly forecast without leaving Maps.



2 GET A FULL FORECAST
To look further ahead in the forecast, press more firmly on the icon to go to the Weather app, which asks whether it should remember the place. You can reject the suggestion if the place isn't somewhere you go often.



3 FIND YOUR CAR
Leaving your car causes your iPhone to detach from its Bluetooth or CarPlay system. Maps marks your car's location if Settings > Maps > Show Parked Location is on. In 10.3, look up your car's location by searching for 'Parked car' in Maps.



Alan's AirPods

Find My AirPods

Audible alerts for locating misplaced earbuds

It's easy to misplace your AirPods, so it's good news that the Find My iPhone app can now help you track them down. The headphones need to be in range of your iPhone, have power, and ideally not be tucked somewhere that the sound they'll play will be hard to hear. AirPods don't connect directly to the internet; they require a connection to your iPhone to receive an instruction to play a sound, limiting this feature's effectiveness — for example, with our AirPods in their closed case (which is itself easy to misplace), they had no such connection.



Speed up an old Mac

Nick Peers dives into Elementary — a Mac-like operating system that's kept up to date — and explains how to install it on an older Mac.

Do you have an old Mac that's incapable of running a recent version of OS X and so doesn't receive important security updates to apps such as Safari? That Mac may otherwise be functioning perfectly well, and it'd be a shame to get rid of it.

Thankfully, there's an alternative operating system, called Elementary, that will keep your old Mac in service, with a desktop environment that's designed with an eye on attracting Mac users thanks to its similar, friendly interface. It's also lightweight, making it perfect for older Macs that are showing their age, and it comes with the essential apps you'll need.

In this project, you'll learn how to install Elementary alongside your OS X installation (and Boot Camp installation of Windows too, if you have one), and how to switch between

them as needed. Although light on resources, Elementary requires a reasonably fast dual-core processor with at least 2GB RAM, so you'll need a Mac from about 2006 onwards, running OS X 10.6.8 or later.

Before you go any further, we suggest you try out Elementary first. The simplest solution is to install Elementary in a virtual machine within VirtualBox (free, virtualbox.org); when setting up the virtual machine, select the Ubuntu 64-bit option, which Elementary is based on. Mount the ISO file (read on) as a virtual DVD drive and you're good to go.

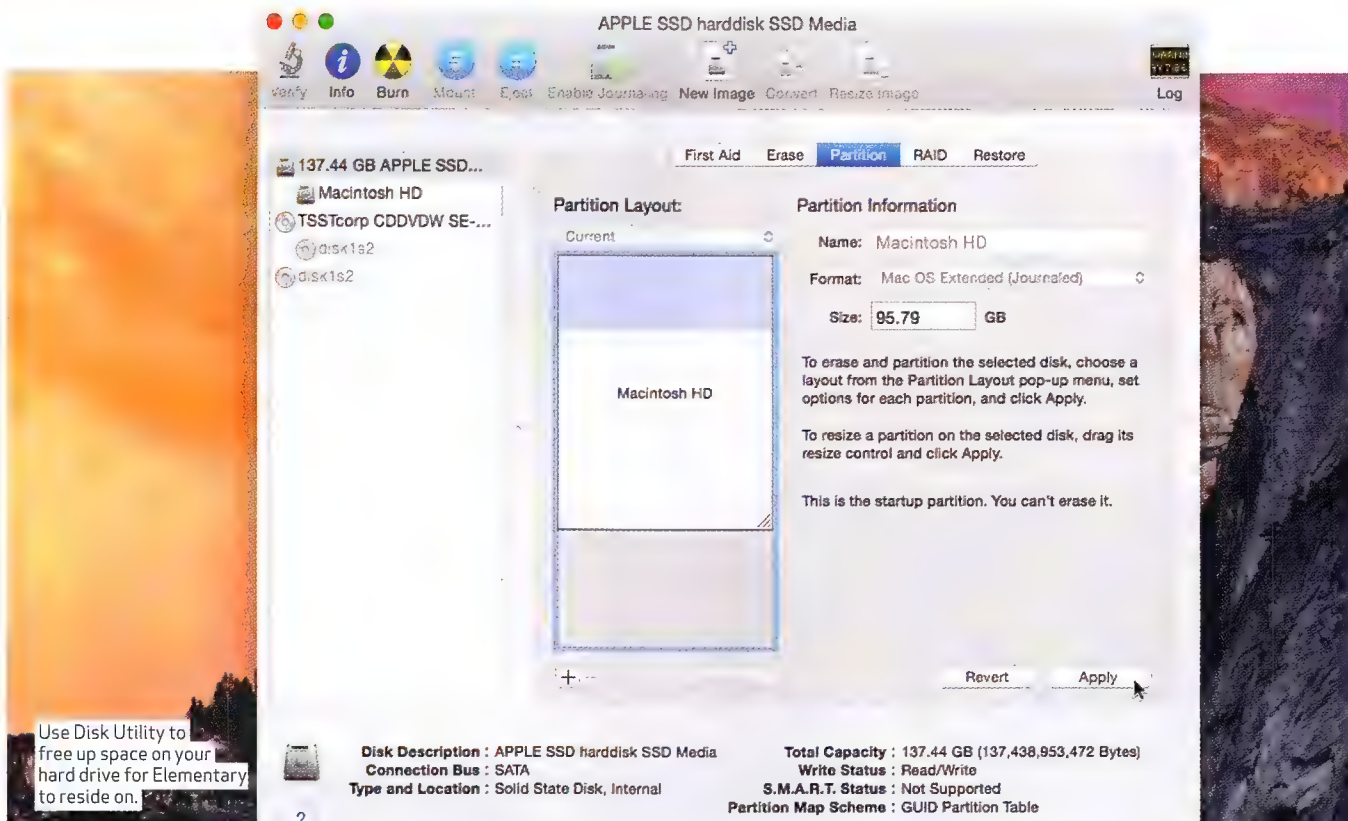
If you decide to then install Elementary as a startup option for your Mac in its own right, perhaps to use as its primary operating system, it pays to take some precautions.

Start by making a full backup of your entire hard drive, so you can roll back

if things go awry. Use a tool like Carbon Copy Cloner (around \$55, bombich.com), and create rescue media that you can use to restore your Mac to its state from before you began this tutorial.

CREATE INSTALL MEDIA

First, download Elementary in ISO format. Go to elementary.io, where you can enter 0 in the Custom field to avoid paying for it, then click 'Download elementary OS'. Save the ISO file to your Mac's hard drive — it's more than 1GB in size. Once done, download and install Etcher (etcher.io). You'll also need a 2GB or larger flash drive; with only one USB drive plugged in, open Etcher, click Select Image and select the ISO file and Etcher should automatically select your flash drive. Click 'Flash!', enter an admin account's name and password, and wait for Elementary's files to be copied to



"If you don't have a suitable flash drive, you can pop a blank DVD into your Mac's DVD drive instead."

the drive. When this completes, you'll be told the drive isn't readable – this is normal, so click 'Ignore'.

If you don't have a suitable flash drive, you can pop a blank DVD into your Mac's DVD drive instead, Control-click the ISO file and choose 'Burn Disc Image' instead. Note that installing from a DVD is noticeably slower.

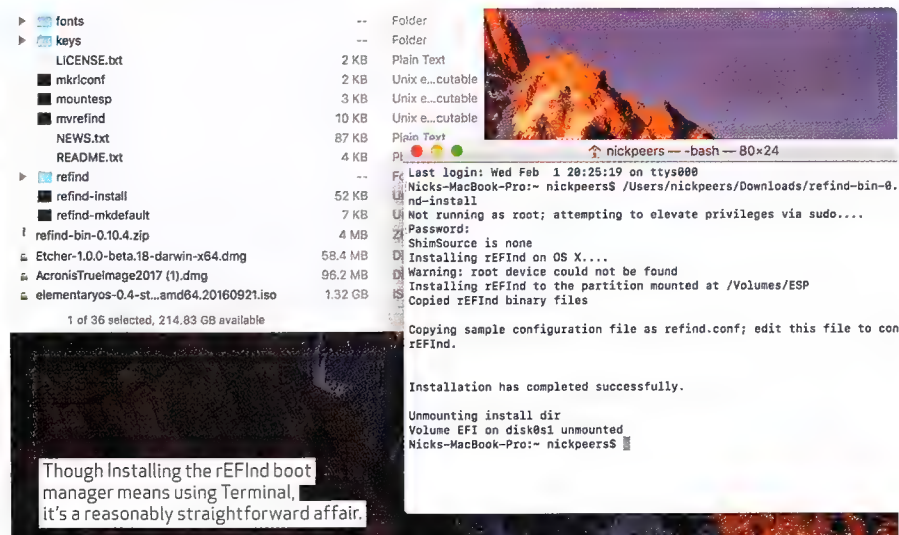
This project is really for versions of OS X that no longer get updates, but if you want to run Elementary alongside El Capitan or Sierra, see the extra details over the page.

INSTALL A BOOT MANAGER

Next, you need to install a boot manager that enables you to switch between OS X and Elementary. This will appear every time you start up your Mac, and shows icons for the available systems; Use the arrow keys to highlight one and press Return to choose it.

Download rEFInd from bit.ly/2kkdZM0 – click the 'binary zip file' link and save the file to your Downloads folder. If Safari doesn't automatically extract the Zip file's contents, double-click the file in

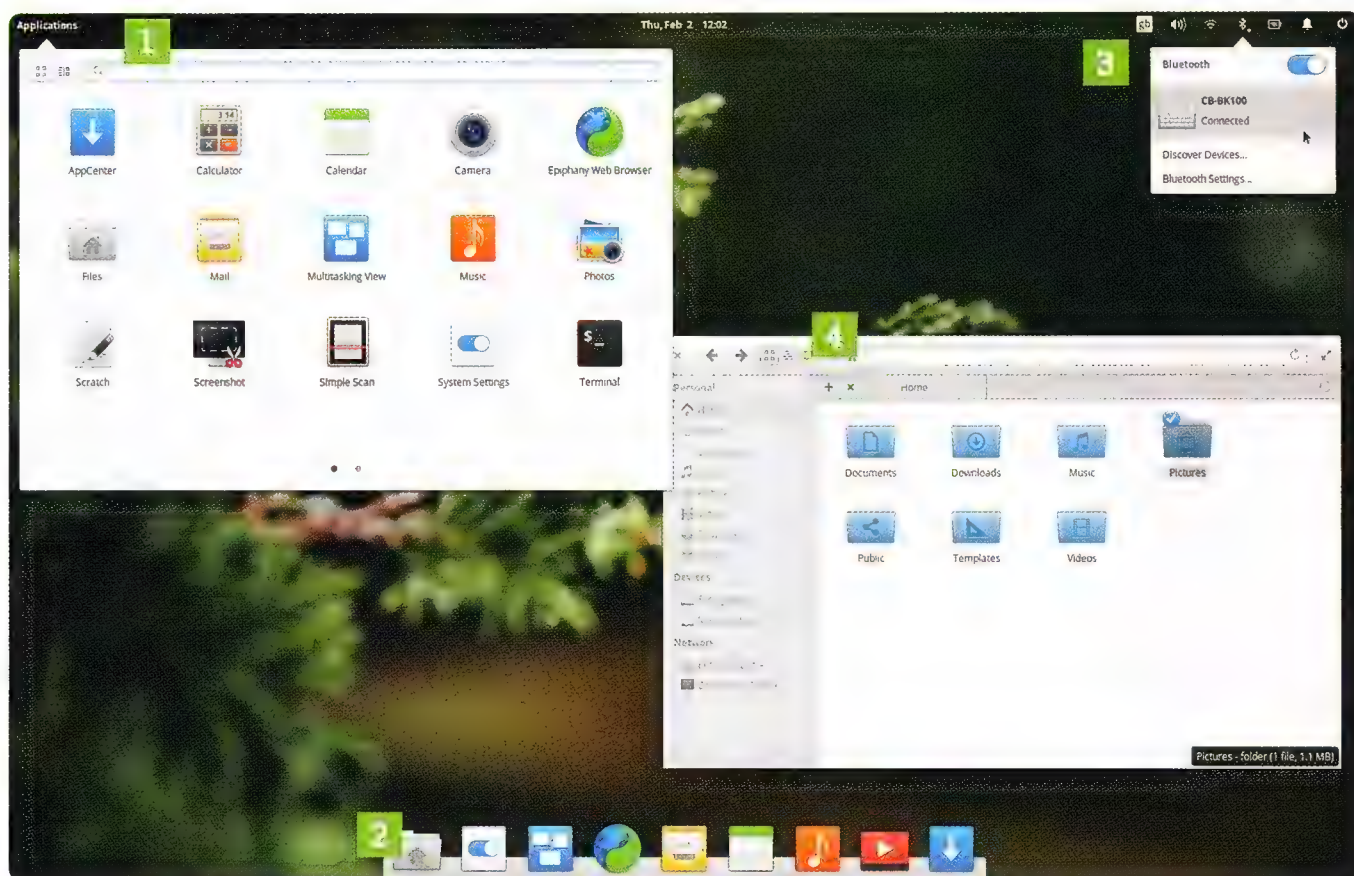
Finder to do so. Open the folder this creates, then open Terminal from /Applications/Utilities and drag the refind-install script file from the folder onto Terminal's window so its name appears in the command line. Press Return and enter your password to install rEFInd. It should end with an "Installation has completed



successfully" message. Restart your Mac and you should see the rEFInd boot menu; it'll always default to the last system you started up in.

PARTITION THE HARD DRIVE

The final preparation step is to free up space on your hard drive for Elementary to reside on. You'll need to take this space from your existing Mac partition (Boot Camp is off limits, so you'll have to take unused drive capacity from your OS X partition). Look to take a minimum of 20GB, or more if you plan to make Elementary your primary operating system on this Mac.



1 APPLICATIONS

Click here to reveal a menu of apps. You can drag and drop their icons to the Dock to pin them there.

2 THE DOCK

Elementary's Dock works in a similar way to OS X's — tailor it in System Settings' Desktop pane.

3 THE MENU BAR

Shortcuts to hardware and system settings up here can also be tailored in the System Settings' Desktop pane.

THE FILES APP

 Access your files in this app, including those in OS X's volume if FileVault has not been used.

Open Disk Utility, select your hard drive on the left (not a volume on it) and click the Partition tab. Select OS X's partition and reduce its size by the amount you want to give to Elementary. Click Apply > Partition, then leave the newly free space as it is.

You're now ready to embark on the installation process. To do so, follow the step-by-step guide opposite.

AFTER INSTALLING ELEMENTARY

When the installation finishes, your Mac will restart straight into Elementary. But wait: what's happened to rEFInd? It's been supplanted by Elementary's own boot loader, but you can restore it: open the Epiphany web browser and download the same binary Zip file as you did earlier. Choose Applications > Files from the menu bar, go to the Downloads folder, and then right-click the Zip file and choose 'Extract Here'.

Open the newly created rebind-bin folder, then right-click inside the Files window and choose 'Open With > Terminal'. Finally, type `./rebind-install`, press Return, then enter your account password and press Return again; a series of messages should appear confirming that rEFInd is the default boot manager once more.

Finally, restart your Mac and you'll find that you're now able to easily switch between OS X and Elementary.

IF YOU USE EL CAPITAN OR SIERRA

To install Elementary alongside these systems, you must temporarily disable System Integrity Protection. Restart your Mac and hold Command-R till the Apple logo appears. When the Recovery system starts, choose Utilities > Terminal, type `csrutil disable`, press Return and restart the Mac.

After installing the rEFInd boot manager, you can turn SIP back on; choose the Apple Recovery option from the boot manager; in the Recovery system, pick Utilities > Terminal as before, but this time type `csrutil enable` to re-enable SIP, then restart. Note: reinstalling rEFInd requires you to disable SIP first.

When prepping storage for Elementary, Disk Utility won't let you create free space; it insists on creating a partition you must later delete when installing Elementary. Select the disk itself and click Partition. Verify you have enough free space, then click '+' to add a new partition. Set its format to FAT32 to make it easier to identify, and set its size accordingly, then click Apply and wait for it to be created.

When you reach the 'Something else' screen in Elementary's installer, you'll need to delete the FAT32 partition, then use the resulting free space as instructed.

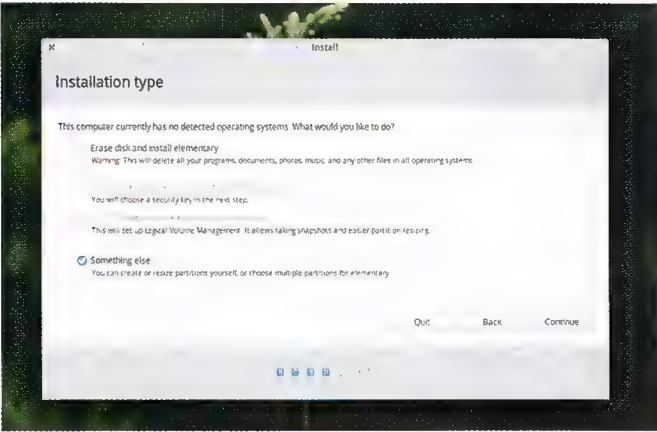
Genius Tip!

- If Elementary can't add a boot loader during its installation, run rEFInd's setup process again within OS X to add the required entry.location for extra protection.
- In System Preferences' Startup Disk pane, pick the volume containing OS X and click Restart to disable rEFInd. To then bring back rEFInd you'll need to reinstall it.

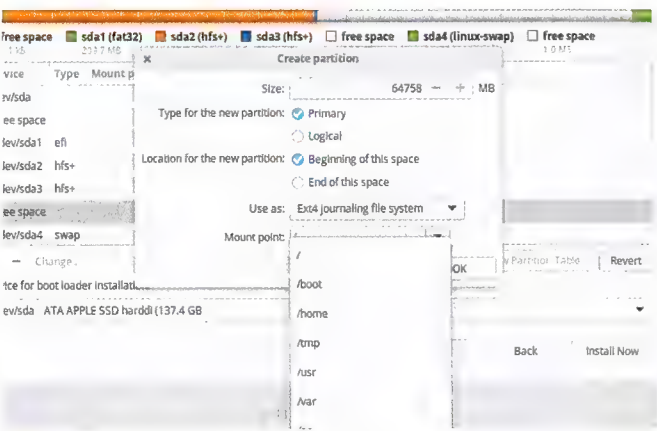
Put Elementary on your Mac



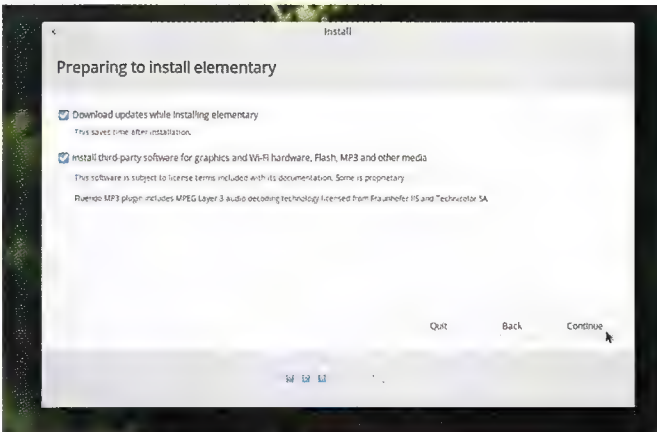
1 FIRST STEPS
After partitioning your Mac's hard drive, restart with the Elementary install media connected. Select the Penguin icon from the rEFInd boot manager, then choose Install Elementary OS and press Return to continue.



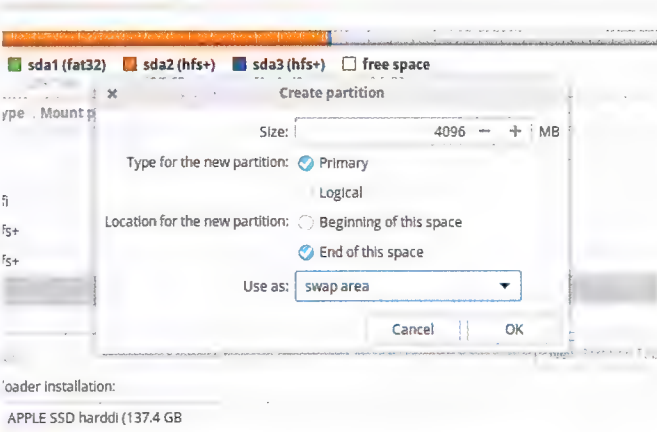
3 CHOOSE INSTALLATION TYPE
Elementary won't be able to detect your OS X installation, so choose 'Something else' at the next screen and click Continue. When the partition table appears, select the free space you set aside earlier and click the '+' button.



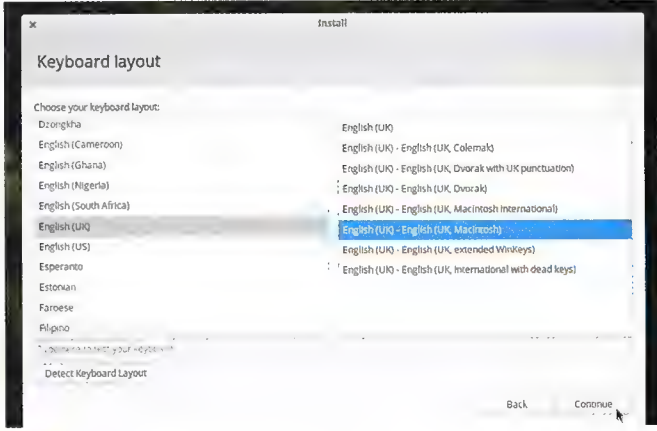
5 FINALISE PARTITIONING
Select the remaining free space and click '+' again. Leave all the settings alone except for the 'Mount point' — click this and set it to just a forward slash (/). Click OK and then 'Install Now'. Review the changes and click Continue.



2 CONNECT TO NETWORK
When the installer appears, select 'English' and click Continue. Connect to your Wi-Fi network if prompted. Once done, tick both boxes to download updates and third-party software, then click Continue again.



4 CREATE REQUIRED PARTITIONS
Set the size in 'Create partition' box to 4096MB to create a swap file 4GB in size (ample for most setups), select 'End of this space', click the 'Use as' pop-up menu and set to 'swap area', and then click OK.



6 COMPLETE INSTALLATION
The rest of the installer is self-explanatory; verify your time zone and keyboard layout, then provide a username, computer name and password. Once done, the installation should proceed to a successful conclusion.

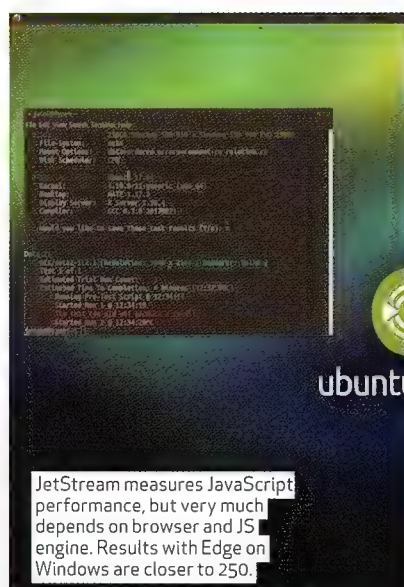
Ryzen on Linux

It ticks all the boxes on paper, but how well is Ryzen supported, and how well does it perform, on Linux? Jonni Bidwell fires up the APC test bench.

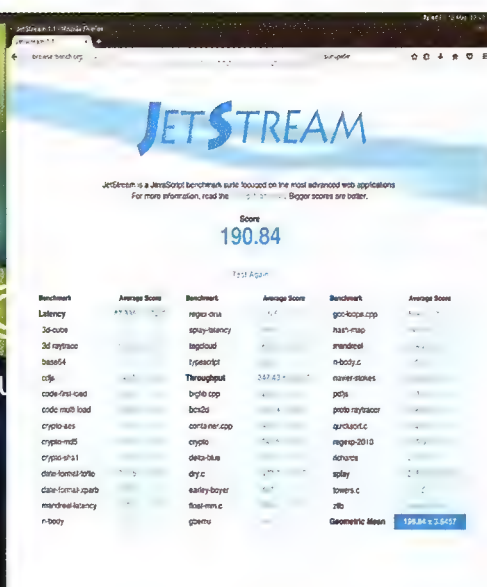
AMD being competitive with Intel once again is an exciting prospect. Free market economics says that should mean better performance and prices for everyone, after all. At least, once retailers have AMD back in stock.

We've seen some impressive benchmarks on the Windows side and we've also seen a few shortcomings. More precisely, we've seen a cheap chip that does exceptionally well for professional workloads such as video transcoding. But also one that falters a little when it comes to single-core performance and serious gaming, at least compared to Intel's latest Kaby Lake flagship, the 7700K. But how does it work on Linux? And what of AMD's wider open-source strategy? Armed with a few review samples, a fresh install of Phoronix Test Suite and an insatiable thirst for filling-in spreadsheet data, we give Ryzen the APC once-over.

In the official launch announcement, its makers were keen to extol its performance compared to the top-of-the-line previous-gen Broadwell-E chips. These match the Ryzen 7's 8-core/16-thread makeup, but also cost well above the budget of many a gaming enthusiast — the top-of-the-line i7 6950X retails in Australia for about \$2,350. In many ways, the 7700K is the more natural



competitor. Sure, it has half as many cores/threads, but multithreading is hard for heterogeneous workloads like gaming, so this won't be much of a detriment. The 7700K also happens to cost significantly less than the Ryzen 7 1800X that features in our tests, so we shall make careful comparisons between these two bits of silicon, too. Benchmarking is a dark art, and it's worth keeping in mind that Linux and Windows benchmarks can differ wildly. Also worth remembering is that new hardware



has teething issues — over the coming weeks and months, we will very likely hear tell of things that don't work as well as they should, and of the resulting fixes.

Our first task was to get a working test bed set up. Fortunately, we'd already done this, using the aforesaid top-of-the-line Ryzen 1800X CPU, 16GB of RAM and ASUS's high-end AM4 motherboard, the RoG Crosshair VI Hero. We started with a fresh install of Ubuntu 16.10, which certainly booted and seemed to work. However, we encountered spurious segfaults during our kernel compilation tests, which was odd, because other tests worked OK and the machine was certainly stable. These went away when we used the 4.10 kernel from kernel.ubuntu.com, but that caused other problems, specifically that the Nvidia driver doesn't build against this, and we neglected to mention that our machine also had an Nvidia 1080 in it. So rather than mess around with ugly patching and manual installs, we raided Zak Storey's bountiful cupboard and purloined a Radeon 470X. Since AMD added a lot of Ryzen-specific code to Kernel 4.10 (some of it has been backported to 4.9), we figured we should stick with this, but instead, we opted to use the second beta of Ubuntu MATE 17.04 so that we could enjoy the general refresh of system packages. As an aside, we should mention that having

BENCHMARKS

BENCHMARK	AMD RYZEN 7 1800X	INTEL CORE I7-7700K	DIFFERENCE
LAMMPS (S)	29.3	26.7	-9%
FFTW (MFLOPS)	21,004	23,987	-14.2%
JOHN THE RIPPER (CRACKS/S)	12,996	12,004	7.6%
TTSIOD (FPS)	315	227	27.7%
GRAPHICSMAGICK (IT/MIN)	242	226	-6.6%
HIMENO (MFLOPS)	1,197	2,911	-143%
KERNEL COMPILATION (S)	77.4	101.5	31%
C-RAY (S)	8.1	19	134%
SMALLPT (S)	38	62	63%
STOCKFISH (S)	3,600	2,905	-19.3%
FLAC (S)	5.21	4.45	-14.6%
LAME (S)	9	8.5	-5.4%
FFMPEG (S)	13.5	7.4	-45.3%
OPENSSL (SIGNS/S)	1,149	839	27%
LIBJPEG-TURBO (MPIXELS/S)	180.1	193.7	-7.5%
BLENDER (S)	566.2	518.8	-8.4%

a modern AMD card meant that we could benefit from the new AMDGPU driver model, which allows you to have entirely open-source video drivers. To ensure this card got the support it deserved, we upgraded Mesa to the version 17 (or 13.1 in the old versioning scheme) stack from the xorg-edgers PPA.

A great deal of early Linux Ryzen 1800X benchmarks were released on Michael Larabel's Phoronix site, based on their test suite, and for the most part, these showed an eminently capable processor that certainly gave Intel a run for its money. We started by rerunning a selection of these, and our results more or less tallied with Michael's. Check out the table to see the exact values, and check out openbenchmarking.com for details of what the tests involve.

As highlighted by Phoronix, the general picture is of a chip that does well at workloads that scale efficiently over multiple cores and threads, but struggles at certain single-core workloads. The most glaring disappointments were the Himeno Poisson pressure solver (which was less than half as performant as on the 7700K), and FFmpeg which took longer to decode h.264 video than the i5 4670 chip, which was Intel's sweet spot two generations ago.

Chess isn't really taken seriously as a benchmark, but the Stockfish engine actually provides a reasonable workout for a CPU. It analyses game trees, which branch plentifully (there are often lots of moves to choose from) and evolve in a non-uniform manner. So there's plenty of opportunity for parallelisation, but a given position may lead to checkmate quickly, or may open many more doors.

Essentially, there are lots of differently shaped and sized workloads, and getting through them all will be a challenge for any CPU.

As it turns out, the Ancient game of chess is not some weird Achilles' heel of the Ryzen architecture – the chip

Freedom over the horizon?

The Ryzen release gave tech pundits a lot to, uh... process, in terms of decoding the marketing speak, running independent benchmarks to compare with those promulgated by AMD, and — most importantly — deciding whether they should invest in the new chippery. But for open-source denizens, there was another surprise: AMD representatives on Reddit acknowledged the possibility that they might eventually release the necessary bits that would enable free firmware, such as Libreboot, to run on Ryzen-powered machines. The Free Software Foundation is especially concerned by AMD's Platform Security

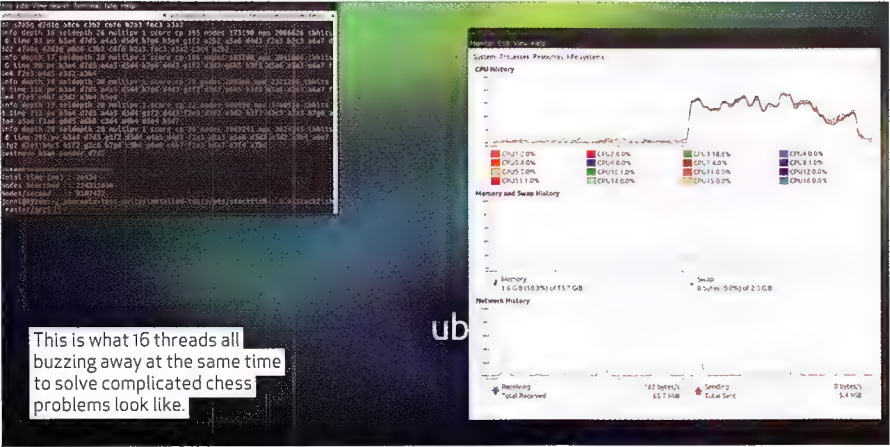
Processor (PSP), as well as the rival Intel Management Engine. This code runs on independent ARM processors that initialise the x86 cores and potentially has transparent access to anything that system is doing henceforth. But there are other components and keys that would need to be released before a free boot process can be had, (see Libreboot's call to AMD at <https://libreboot.org/amd-libre>), and if there is any progress here, it will likely be slow and convoluted. Up until 2014, AMD released the source for their AGESA firmware, so perhaps we can hope for a return to at least this kind of partial openness.

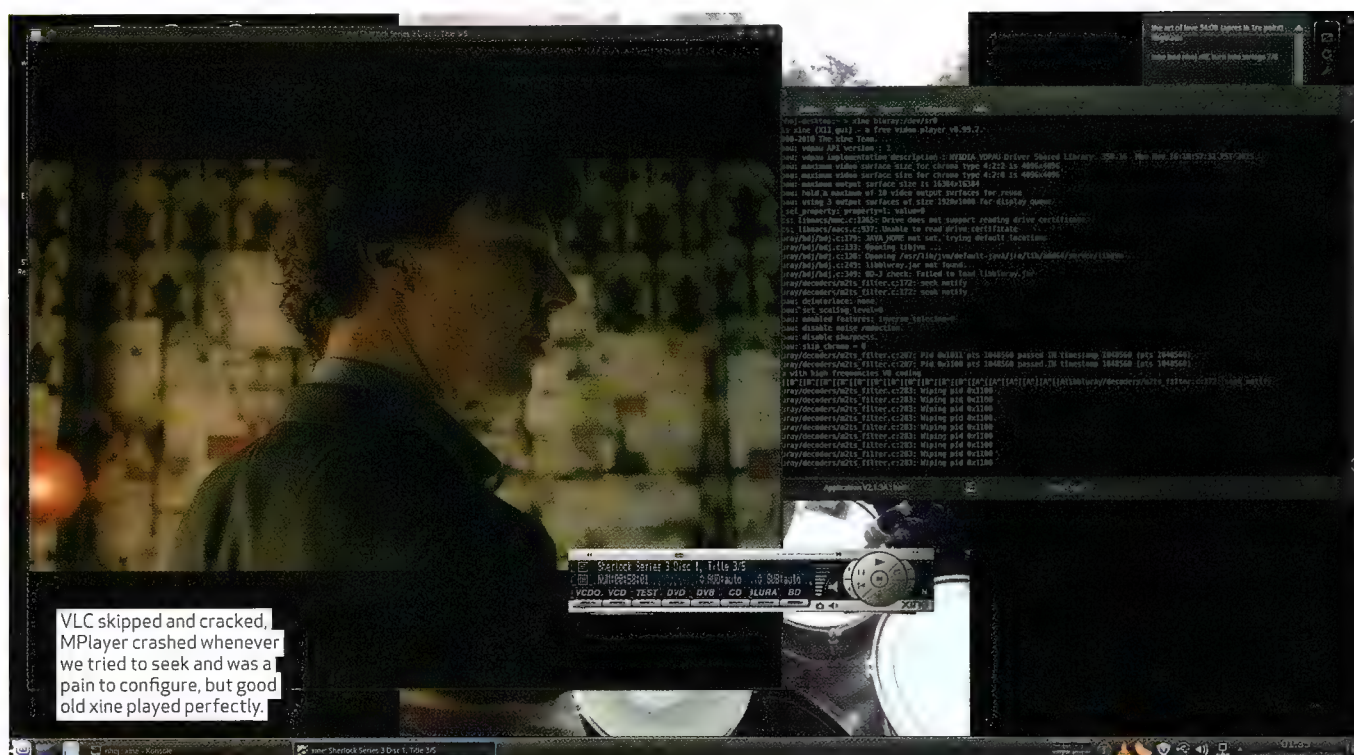
performed marginally worse than the i5 4670 in Phoronix's benchmarks and ours corroborated this. However, the problem lies in the benchmark itself, which doesn't feed Stockfish suitable parameters for a many-cored processor, and ought to measure the rate of the test (nodes/s) rather than the overall time taken, since the number of nodes (positions) changes with each run. Some details are available in this post <http://bit.ly/2o5aFK4>. Ultimately, the benchmark is just measuring single-core performance.

As it turns out, Ryzen is a fine platform for playing chess. We saw it peak at 8.8Mnodes/s using a hash size of 512, 12 threads and a depth of 20, which is pretty meaningless without context (other Stockfish benchmarks use different settings), so we tested it on the FX8350, the one-time top dog of the previous Piledriver architecture. It peaked at 5.5Mnodes/s. It is interesting to see how it scales with thread count. As you can see, throwing more cores at a problem is not always the best way to solve it quicker.

Ryzen is a new architecture and it would be foolhardy to just assume that all existing binaries out there will understand the platform and be able to make best use of it. It's been noted the ALC1220 audio codec found on a number of AM4 boards will not be supported until Kernel 4.11. That said, the required code will be easily backported, so users of fixed release distros won't have to wait too long after the 4.11 release in order to have functioning audio. Likewise, at time of writing, the chip's thermal sensors weren't yet available in lm_sensors, so we don't have evidence of how hot under the collar the chip gets. Also there are some other platform components that lspci can't identify, describing them only as "Non-Essential Instrumentation". This we found amusing.

In the weeks following Ryzen's release, reports began to circulate that Windows 10's scheduler was not being kind to Ryzen, and that disabling Symmetric Multi-Threading (SMT) features actually improved performance. These rumours have since been firmly debunked by AMD, but do provide this tenuous segue into a kernel patch signed off in early February (<http://bit.ly/2mRbh53>). Here, we see an AMD employee contributing kernel code to fix SMT scheduling topology. They probably do this on Windows too, but the process has to take place behind closed doors – with Linux, it all happens in the open. Ryzen-specific optimisations first appeared in GCC 6.1, so those who aren't afraid of compiling their own programs can try the `-march=zn1ver` switch for extra performance. ■





Using Blu-ray on Linux

Is running Blu-ray on Linux smooth sailing or more like banging your head against the wall? John Knight finds it's a little bit of both.

Any Linux user who has tried to play a Blu-ray disc will have made the unpleasant discovery that they don't just immediately play and that some legwork is required. A quick Google search will reveal varying states of grimness, and depending on when the online article was written, you will receive differing accounts on how to

play Blu-rays, and just how useful Linux/Blu-ray is right now.

The problem lies in copy protection and legal issues. Although Linux is more than capable of playing Blu-ray titles with perfect performance (there is a decent chance that your Blu-ray player is, in fact, running a Linux kernel), since their inception, Blu-ray discs have been closely guarded by

a draconian form of digital rights management. On top of this are legal differences from country to country as to what one can and cannot do with digitally protected media, creating further headaches for developers. And just to make things that little bit harder, there are vested interests from a conglomerate of major corporations, including Microsoft, who, back in the day, would have had little desire to see Linux users have easy access to Blu-ray.

So is it all doom and gloom for Linux users? How do we play Blu-rays, and why can it be so hard in the first place? Let's see how Linux/Blu-ray looks in 2017 and try to get it working in the process.

Project: www.labdv.com/aacs

If you're as lazy as us, you glanced at the instructions in that URL just given and thought, "Too hard, can't be bothered." But stick with it — it's easier than it first looks. You're going to install some libraries, download a file and then copy it somewhere. That's it. Two minutes and you're done.

First, open your package manager and install the packages 'libbluray' and 'libaacs' (it's probably also worth installing the 'dev' packages while you're there). Now download the

Caution: Old websites!

Beware of an old web page that may be your first Google result, going by the URL: vlc-bluray.whoknowsmy.name

It has an old key file from early 2016: do not use it! If you use this file, your Blu-ray success rate will drop from about seven out of ten to something like four out of ten — a mistake we found out the hard way! This link may still be included in a number of manuals and tutorials, so if you've written some older documentation yourself, please update the link.

The correct, up-to-date link is: www.labdv.com/aacs

If you visit this page, you will likely get a key database file from the last few

days and infinitely more keys than the old 2016 file. Also included are links to further libraries and useful programs, along with added documentation, and the all-important link for uploading keys. Note that a number of tutorials and programs are hosted on the 'doom9' forums rather than a central web page which makes the process all a bit anarchic: some of the links no longer work and some tutorials need updating (which are unfortunately in crucial areas if you're a Linux user trying to generate a Blu-ray key). This had us running in circles for a few weeks, so hopefully their old info can be updated soon.

Blu-ray keys file from the URL provided (filename KEYDB.cfg), and copy it to the folder: ~/.config/aacs.

For any novice users, anything with a . before the file name is a hidden file or folder. So if you want to use a graphical file manager, turn on 'Show Hidden Files', and open the .config folder hidden in your Home directory. If the aacs folder doesn't exist then create it, and copy the keys file there.

For grumpy command line veterans, just enter these two commands:

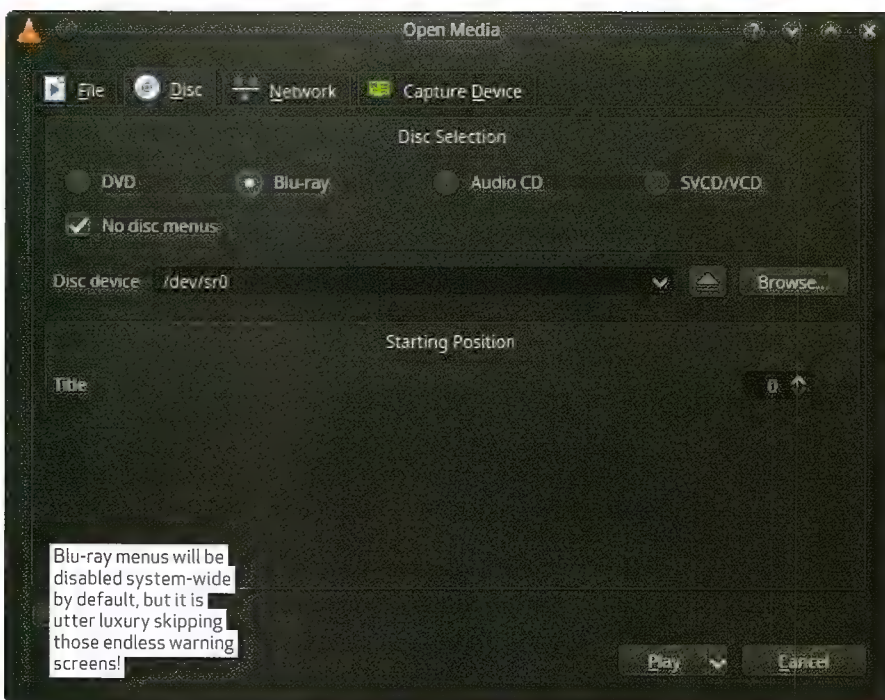
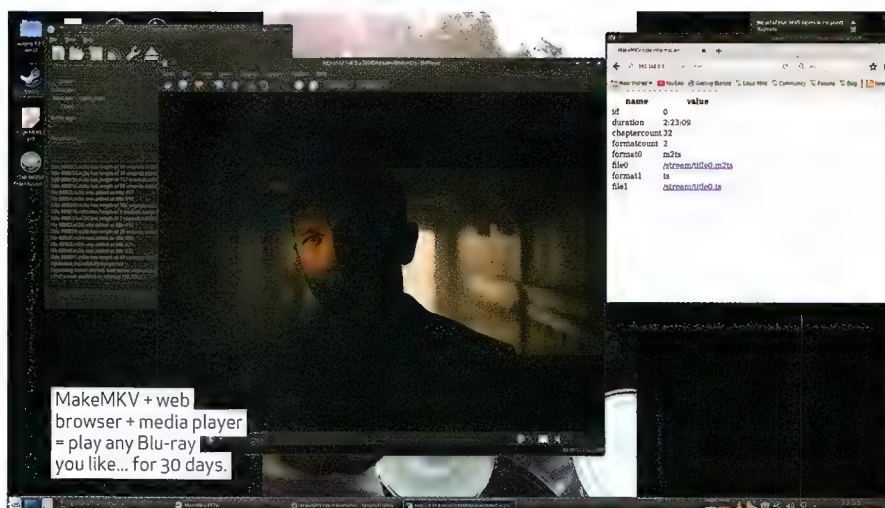
```
$ mkdir -p ~/.config/aacs/  
$ cd ~/.config/aacs/ && wget  
http://vlc-bluray.whoknowsmy-  
name/files/KEYDB.cfg
```

Let's get this out of the way now: there's a reasonable chance your disc won't work. Don't panic, because we'll explore what to do from there, but of the 10 discs we tried, three didn't work. This is due to encryption issues, which will form the second half of the article, but for now, just grab a selection of Blu-rays to maximise your chances of a working title.

Unlike DVDs, you have to mount the disc first. Just use your desktop's device manager — you don't need to do any fancy command line stuff here.

VideoLAN is the best place to start because it's the easiest way to find out if a disc will work, without needing to use the terminal. Click the Open Disc dialogue and choose Blu-ray. You'll see 'No disc menus' ticked — just leave that alone for now and we'll re-explore it later. Now click Play and with any luck your Blu-ray will fire up. If not, move onto the next disc.

Congratulations if your movie is playing without incident — unfortunately, there's a decent chance that you'll have some kind of performance issues, such as skipping and cracking. You may, however, be able to work around this by tweaking your settings, such as lowering the quality (which kind of defeats the point of Blu-ray), or setting all the video drivers to 'VA API'.



"We just want to play the discs we've bought without having to change OS."

Is this legal?

Private copying of copyrighted material is illegal down under, but the concern of this article is with rightful access to legally purchased Blu-rays. On Linux, this unfortunately requires digital circumvention — something that has been hotly debated for years and continually head-butts against Fair Use Rights. In the United States, the Digital Millennium Copyright Act (DMCA) criminalises decrypting protected content (even if legally

purchased), and US courts are still fighting over DMCA versus Fair Use, so the practice in the USA remains illegal.

The law in the UK has been quite draconian in theory, but liberal in practice and has been under constant discussion for years, as the interests of copyright holders continue to run counter to practical realities. Personal copies are legal if you live in Spain, the Netherlands and here in Australia, but do not distribute that material.

The area is muddy as these laws are primarily for restricting the sharing of content, not keys. To further muddy the waters, circumvention tools may be legal for non-infringing purposes, but the production and distribution thereof will not be. Legal exceptions may exist for circumvention for the purposes of journalism, critique or comment, and non-commercial videos. So is this legal? We're not lawyers and cannot answer that. Seek sound legal counsel.



Now let's try MPlayer. Our favoured GUI, SMPlayer, didn't have a dialogue for playing Blu-rays so you may need to use the terminal like we did. Panic not, though, as it's dead easy. Assuming your drive's device name is 'sr0' enter the following command – otherwise just replace your drive's device name:

```
# mplayer br:////dev/sr0
```

And yes, you need the four slashes – don't ask us why.

On our machine, the playback was much more stable than with VideoLAN and played without any skips, dropped frames, or graphical corruption. However, and it's a big however, trying to seek through the video usually crashed MPlayer, whereas VideoLAN sought just fine. Furthermore, unless you've edited your config file, MPlayer will default to stereo, meaning that if you want surround sound, you'll need to play around with some very awkward command line switches (which is not fun at all).

Neither of these players were working out for us, and we were very surprised to find a saviour in our long lost friend xine. If memory serves correctly, xine's GUI dates back to the '90s but don't discount it, because

(a) it worked for us far better than VideoLAN or MPlayer, and (b) it's easy to configure your driver and sound options (such as speaker setup, digital or analogue sound, using Nvidia's VDPAU driver, and so on).

Although xine has a Blu-ray button it didn't work for us, so you'll probably need to use the terminal. But once again, fear not – it's even easier than MPlayer! Just enter this command and enjoy the results:

```
# xine bluray:/dev/sr0
```

Ultimately, if VideoLAN is working without performance issues then stick with that: you can seek without crashing, and you can even use menus if you have experimental libraries installed. But most importantly, you can open a disc without having to faff about in a terminal. Nevertheless, the aforementioned Blu-ray performance issues are very common, though the VLC team are promising much better performance in version 3.0. For now, ye olde xine might be your best bet if you don't mind entering an easy terminal command.

MAKEMKV

So why didn't some of your discs work?

Because in order to watch an encrypted Blu-ray – which will be most of them – you require a key: from keys that were in the file you downloaded earlier. If the key isn't there, you don't get access. Depressed? Well, there is a work-around... for the moment.

MakeMKV is primarily a ripping program for decrypting Blu-ray in order to rip disc contents into Matroska videos, but it also has the wonderful ability to stream movies to a local port which can then be run in almost any player. So what's the catch? For one thing, it's shareware (we didn't realise it was 1992). And it has a trial period of 30 days, after which you need to pay for it. Nevertheless, it is a pretty damn cool app and worth checking out.

If you head to bit.ly/1HJcdn, you'll find a forum thread with the Linux version and installation instructions. We're sorry to say we don't have the space to cover the installation, but we can tell you that it is slightly convoluted by two tarballs, though no harder to install than your usual source tarball. Thankfully, they had the good manners to provide the package names for needed libraries and even a command for Ubuntu derivatives.

When you stream a disc, you can't just copy the URL given by MakeMKV and paste it into your player – nothing will happen. You first need to open the URL in a web browser where you can then navigate through the disc structure. Choose the title number you want, copy the link location from the browser, and then you can paste the needed URL into your favourite player.

Speaking of which, we found VideoLAN was glitchy with constantly cracking playback; however, SMPlayer gave excellent performance. Note that if you have no sound, you may have to change audio streams from your player menu: audio streams might not produce sound if it's a direct surround signal and your sound setup is something like analogue stereo. If you have a surround amplifier, choose digital out ('AC3/DTS pass

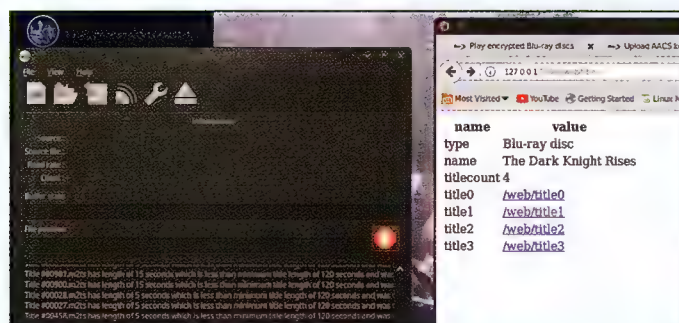
Streaming with MakeMKV

Trying to stream Blu-rays with MakeMKV can be confusing at first, as the given address won't work in your media player. Worry not, it's as easy as one, two, three...

1 — Copy the address in MakeMKV's output text (<http://localhost: 51000/>) and paste that into your web browser.

2 — Here, you'll be provided with an HTML interface to browse the disc's structure: chances are the film will be on 'title1' and the file duration should provide a clue as to which file is which.

3 — Copy the address of the title you want and now you can play it in just about any player you like.



through S/PDIF' with SMPLayer) under Sound Options. (If you have a cheap sound card, you might be out of luck, sorry.)

EVIL ENCRYPTION

So what makes Blu-ray so hard to support, and why can't we just crack its encryption the way we eventually did with DVD? Jean-Baptiste from the VideoLAN team: "Blu-ray is quite complex to support, for two major reasons: DRM and Interactive Menus. The video part of the Blu-ray is not that hard to do, since it's regular codecs, but the packaging is very complex to handle.

"Indeed, menus, navigation, bonuses and games can either be done in a simple format, similar to DVD menus, or with a Java runtime called BD-J. As usual, there are no public specifications, and even if there were, a lot of the discs don't really follow it, so that requires a lot of work.

"DRM is of course the second big mess. Blu-ray has multiple layers of DRM. The two that are of interest to us are AACs and BD+. AACs is a documented crypto-system that relies on cryptokeys and certificates. The open-source community has a good implementation of this, but without the keys, it's not really useful. And the keys are per-media, per-software and per-drive and they get revoked all the time.

"To give you an idea, inserting a new Blu-ray could revoke your drive certificate and then you wouldn't be able to read any Blu-ray with this device until you updated the firmware! Even the ones that you already played! So people share large configuration files containing disk keys on various websites... Not fun.

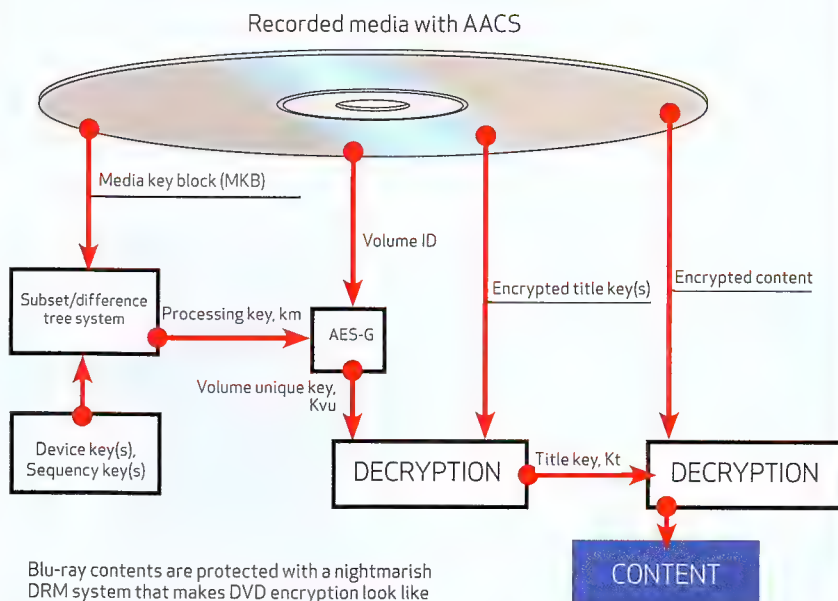
"The second DRM is BD+, which is a full virtual machine that executes the DRM code that could come with the disk (we're not joking). It's very hard to implement correctly, and integrates also with the Java layers, and has certificates too. There are no good open-source implementations of this system."

So how does Joe Public fight back against The Man, to rightfully play his own discs? Well, the chief ways are supplying keys and bug reports on menus, with keys being the most needed resource — although for legal reasons, we cannot endorse this.

Being an experimental technology, Blu-ray menus are disabled by default. According to the Arch Linux wiki, Blu-ray menus can be used if you install 'libbluray-git' instead of 'libbluray', so you might need to do a little digging if you'd like to get menus working and contribute bug reports.

So what about keys? Well, that's where things get harder. If you have

AACS that FLA explained...



a Windows system about, then you're well catered for: just follow the link to where you can upload keys and read the info on what software to use, and how to use it. Linux on the other hand is a great deal harder: MakeMKV no longer works the way the given how-tos rely upon — they reference files and folders that don't seem to be there any more — and further software and documentation is buried away in an endless maze of forum posts.

Despite spending several weeks chasing down leads and trying different methods, we just couldn't get our software to squeeze out a key. And although we'd like to provide you with a simple guide on key grabbing, we'd probably find ourselves in considerable hot water — so if you'll forgive us, we'll remain deliberately vague here. Either way, follow the links and forum instructions, and hopefully you'll fare better than we did.

WHAT'S NEXT?

Perhaps you're depressed by this state of affairs, but seven out of ten discs (at least in our quick test) isn't too bad a hit rate, is it? Plus, running without menus by default is actually kind of refreshing: instead of wading through endless menus and warning screens, you're in the movie in a matter of seconds. Looking at where Linux Blu-ray was a few years ago, we can confirm that development has come a long way, and will only continue in leaps and bounds if we can really get behind it as a community.

Keys and menu testing aside, what we really need to provide as a community is boring old leg-work

and organisation. We're not trying to be rude towards the developers, but these last few weeks have been an endless maze of old and broken links, outdated documentation, and broken bootstrap files. It's understandable. These people aren't being paid for this, and maintenance is the tedious aspect of any software project. Most programmers just want to get on with the coding. If you would like to contribute somehow but can't program yourself, perhaps you can help out in these tedious admin jobs, and provide updated how-tos so that the coders can spend more time on real tasks?

For any angry film executives who might be reading, most of us probably aren't even interested in ripping, and just want to rightfully play the discs we've bought without having to change OS. As far as we know, there are no commercially available Blu-ray players for Linux, and even though we are open-source advocates, we'd still be interested in a shrewdly-priced proprietary program if given no alternative — unless you can tell us better.

So where do we sit in terms of project completion and Blu-ray perfection? We'll give Jean-Baptiste the final word on that: "For code, it's mostly done. For keys, it will be a long and never-ending battle."

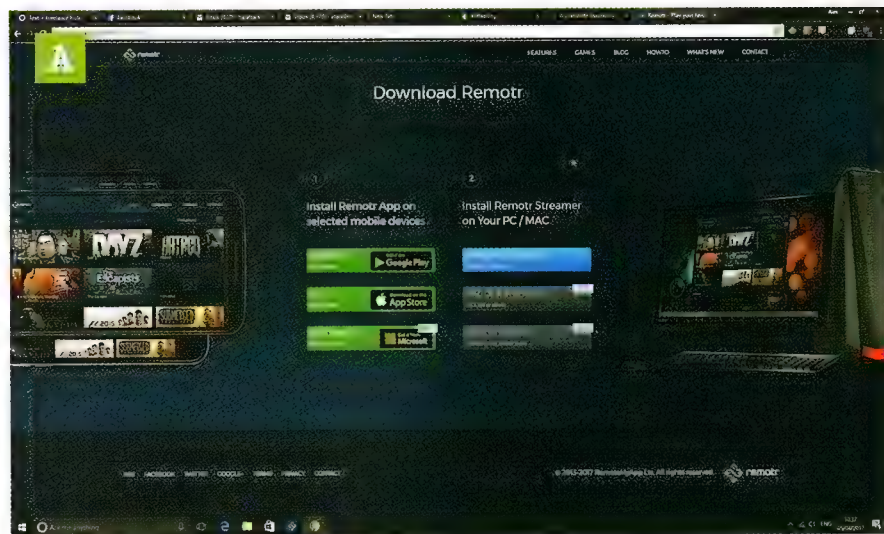
For more pointers on Blu-ray playback than you'll know what to do with, see the excellent Arch Linux Wiki: <https://wiki.archlinux.org/index.php/Blu-ray> ■

Play PC games on your smartphone

If you've got the data and a PC, Alex Cox has the solution.

We're not short of options when it comes to streaming games. We've talked in these pages about the immensely useful Steam In-Home Streaming, we've covered the likes of XSplit, which sends your games up to Twitch and other online streaming services, and we've even looked at ways you can beam console games through your network and play them on your PC. Well, add Remotr to the list. It's very flexible, offering up client apps for smartphones, tablets and other Windows PCs, happily streaming over mobile phone networks if you have the data allocation for it, and it's incredibly simple to set up and use.

Let's preface this a little, though, with a couple of caveats. One: don't expect ultra performance or lag-free gaming. Remotr's solution is quick and very well coded, but it's not going to be suitable for the twitchiest games, particularly if you're streaming outside of your local network. It also scales down the quality of streaming (though not the quality of the source game) to meet your network specifications, so if you're obsessed with uncompressed graphical fidelity, you might be best staying at your home PC.



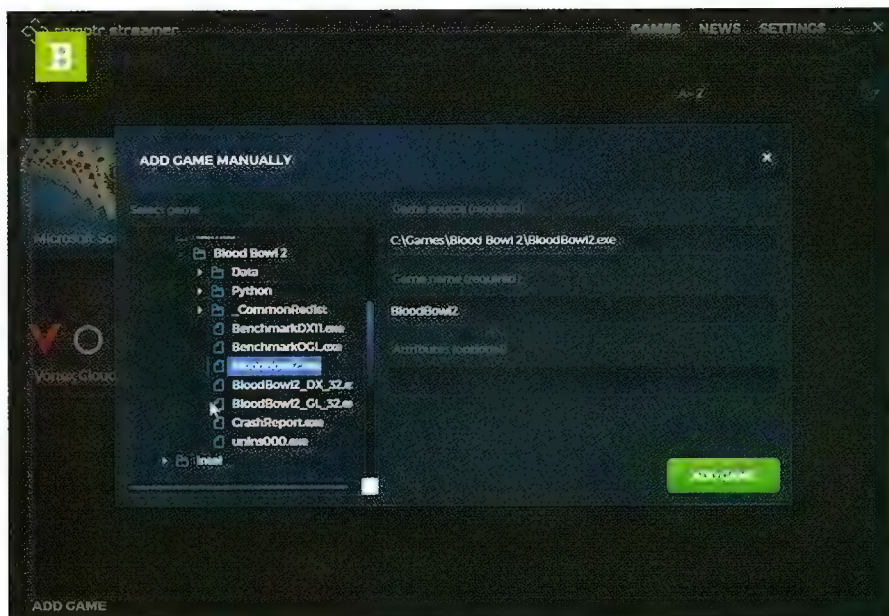
1 GET THE SERVER

Remotr works on a client/server model, which means you first need to install its server app on your gaming PC. Head to remotrapp.com, scroll down until you find the relevant option **[Image A]** and download the Windows Streamer app. Run it to install Remotr, open up the app, and click the 'New Account' button to set up an account. You may wish to sign up with a burner email account from the likes of guerrillamail.com for a couple of reasons: Perhaps you're concerned about

Pi Remote Gaming

If you're looking to send gaming streams to your Raspberry Pi, you may be tired, as we are, of waiting for Remotr's promised Pi app. There is a solution, however, in the form of the decidedly less user-friendly Parsec (parsec.tv). Using UDP (rather than TCP/IP) to stream at super-low latency, it enables you to install a server on your gaming PC, a client on your Raspberry Pi 3, and beam games from one to the other. There's a slight problem, though: in our experiments, we've found it a little unstable and somewhat unwilling to work with certain hardware configurations. Theoretically, you should be good to stream even on machines with Intel embedded graphics — your results may vary.

If you have a decent Nvidia card, there's another solution: Moonlight, née Limelight (moonlight-stream.com), an open-source client for Nvidia's Gamestream protocol. There are versions of Moonlight Embedded, the Pi client, for both Raspbian and Arch, though these are unofficial ports, so we can't vouch for them working perfectly with your particular hardware setup.





getting too much mail from Remotr or its friends (given that there's no option to refuse it) and, if you want to play multiplayer games, everyone's going to need to sign in with the same details.

2 ADD A GAME

Remotr's initial lineup may be a little sparse. It attempts to find games it knows on your hard drive and add them to its interface, and you'll also see a big ad for the affiliated Vortex streaming service, which offers cloud-hosted gaming PCs for a fee. If the game you want to play isn't listed, click 'Add Game' in the bottom-left corner, and dig through your hard drive [Image B] to find its executable. Steam games are generally added to the grid automatically, but if they're not, they're usually found in Program Files (x86)\Steam\steamapps\common. Clicking games in this interface doesn't do anything, but their presence means they're available to any client apps.

3 GET THE CLIENT

There are two varieties of client available: mobile and desktop. The desktop client is relatively easy, in that you simply need to download and install it, log in with the details we set earlier, and you should see your server active and ready. If you don't, or if the client doesn't seem to be able to connect, make sure your PC is awake — use 'Power Options' in the Windows Control Panel to stop it sleeping, if need be — and try bringing the server app into the foreground. You may need to log into Steam, too.

■ Installing on mobile is just as straightforward. Find Remotr in your device's app store — it's available for both iOS and Android — and get the app installed. Log in, and you'll see your server; tap it, select a game and (after you've watched an ad) you should be up and running. If you hit any snags, head to your server, and check the graphics settings for individual games, to ensure they're running in windowed

"The best results, naturally, come with higher network bandwidth. It's possible to stream over Wi-Fi, though results are unpredictable."

or borderless full-screen mode. In general, proper full-screen mode doesn't play nicely with any kind of streaming or screen capture, and Remotr is no exception.

4 CONFIGURE CONTROLS

Playing on desktop is no trouble, as your controls are translated entirely. If you have a mouse and keyboard, they work on a PC client exactly as they do on your server machine. Plug in a gamepad, and that should work perfectly, too. On mobile, though, things are a bit different. By default, Remotr uses your phone's screen as a touchpad, translating swipes into mouse movement and taps into left clicks. It may also, in some cases, presume you'd like to use a gamepad with your target game and stick an overlay on your screen [Image C]. This can be configured, and any additional controls added to the overlay, by tapping the Remotr icon in the top-right and selecting 'Edit Controls'. Thankfully, given that PC

games are rarely built to have massive thumbs all over them, you're also free to use Bluetooth controllers or, on Android, wired gamepads with a USB OTG connector. These can be configured in the Settings section [Image D].

5 BETTER SETTINGS

The best results, naturally, come with higher network bandwidth. It's possible to stream over Wi-Fi, though results are unpredictable, and you may experience some input or sound lag to go with the degraded picture. Hooking your server up to your router via Ethernet is the first step, and using

a similar wired client is the second, though this obviously isn't possible if you're blasting games to a mobile device.

- Check the Settings screen of the server app, too, for the switch that enables you to activate GPU acceleration. This aids the stream encoding by allowing your GPU to chip in a little processing time, but obviously strips a few cycles away from the game you're trying to run. When streaming, this isn't a huge problem, although you may need to dial back the rendering settings of your games to compensate.
- If you're using a high DPI display, we suggest you drop your screen resolution before streaming, for obvious reasons. There's a switch in Settings to automatically drop the resolution when using mobile devices — sending 4K to a 5-inch screen doesn't make a huge amount of sense anyway — but no way to do this automatically when streaming to a PC client. ■



Turn your home PC into a personal VPN Server

Secure your browsing, even when away from home. Cat Ellis explains how.

If you travel frequently – for work or fun – you’ve probably found yourself in a hotel room or a café with a Wi-Fi password scribbled on a sheet of notepaper and no idea how secure the connection is. Sometimes, you might be able to tether your laptop to your phone, but most plans don’t let you make wireless hotspots unless you pay an extra fee, and it’s very easy to chew through a whole month’s data allowance as Windows decides it’s a good time to perform some critical updates.

You can get around this problem by using a PC at home as a proxy server. Rather than data traveling directly from your laptop to the web server, it’s sent via a secure encrypted connection to your home PC, which then forwards it.

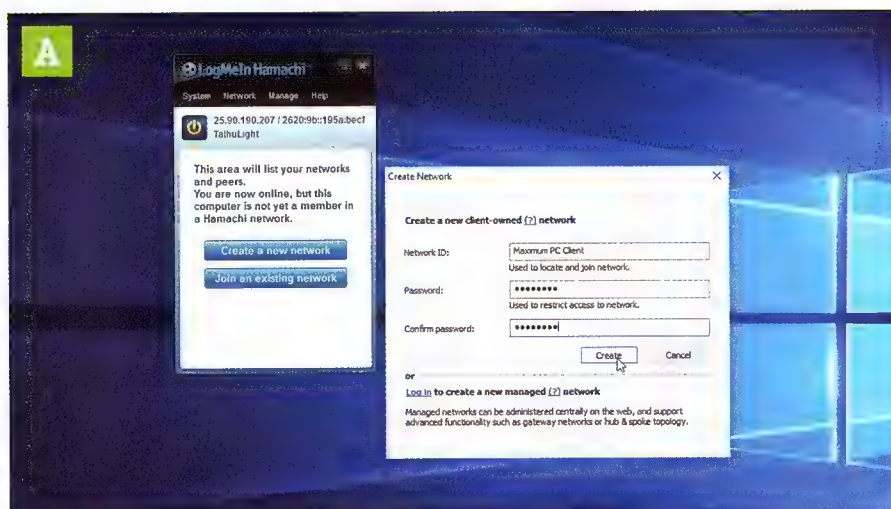
This technique is only for avoiding eavesdropping on potentially unsecured public networks – it won’t hide anything from your ISP. It’s also worth noting that your internet connection speed will be slower than it would be at home – particularly if you’re a long way from home when you log on.

We’re using a free VPN tool called Hamachi, which is mainly used by gamers to create virtual local networks, and non-caching web proxy Privoxy. Here’s how to set it up.

1 PREPARE THE SERVER

This guide requires two PCs: one (a desktop or laptop) to act as the server, and a laptop, which will be the client you’re carrying on the road. The server PC must be powered on at all times – something to bear in mind if you’re traveling for several days.

Using the server PC, download LogMeIn Hamachi from www.vpn.net, and run the software installer. When the program starts for the first time, click the power button to activate it, and you’re prompted to create a user account, which is used to manage all your virtual networks and their users [Image A]. Do so, then verify it using the link that’s emailed to you and re-entering your password. Click ‘Create a new network’ and enter a name and password. The name can be anything you like – Hamachi identifies



you using your account and device ID, so this is just for your reference.

2 START SETTING UP THE CLIENT

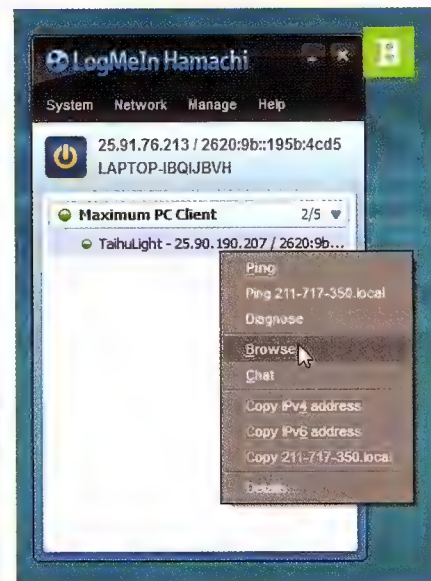
Now install Hamachi on your laptop, and log in using your account details. You’re sent an email notification each time you log in from a new device as a security measure, but you don’t need to authorise the connection. Select ‘Join an existing network’, enter the network name and password you created earlier, and click ‘Join’.

The name of your desktop PC appears. Right-click it and select ‘Browse’, then enter your usual Windows account login details, and you’ll see that you can access the desktop PC’s filesystem [Image B].

If you have trouble connecting to the network, you might need to take a look at Windows’ firewall settings, and make an exception for Hamachi. Right-clicking the client PC’s name in Hamachi gives you the option of diagnosing network problems, but it doesn’t offer any guidance.

3 CONFIGURE PRIVOX

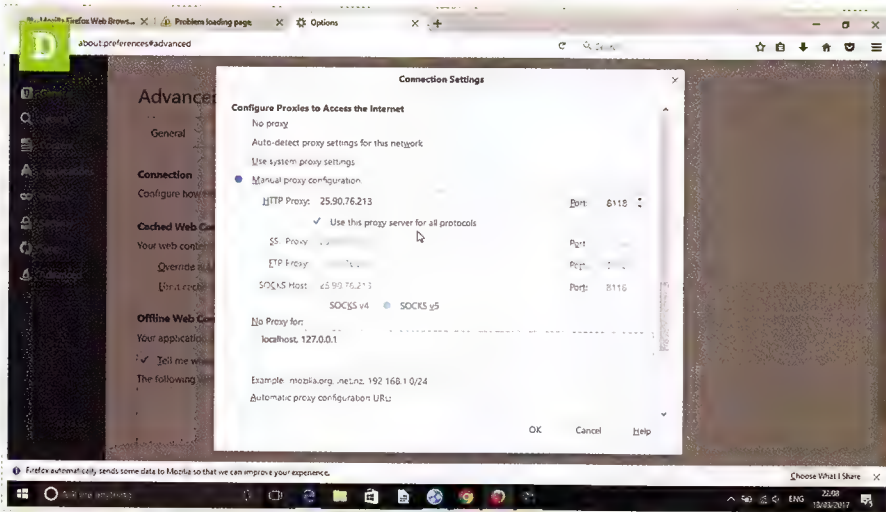
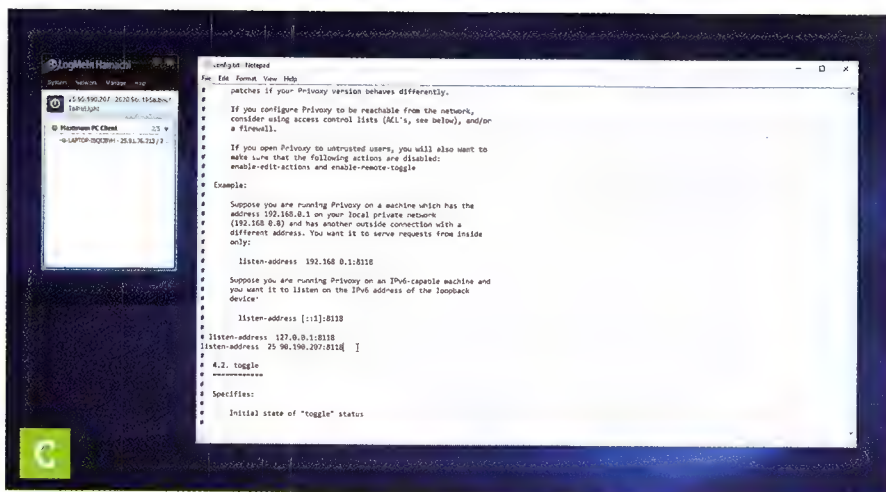
Now return to your client PC and download Privoxy from www.silvester.org.uk/privoxy/Windows – the latest stable version of the Windows installer is ‘privoxy_setup_30_23.exe’. Run the installer, then close the empty window that appears. Privoxy doesn’t have a GUI like Hamachi, so right-click the new



Privoxy icon in your system tray, and select ‘Edit > Main configuration’ to open the main settings file [Image C].

Scroll down the text document to section 4.1, and find the line `listen-address 127.0.0.1:8118`. Type a # in front of this line to mark it as a comment, then underneath it type: `listen-address [the IP address at the top of your Hamachi window]:8118`

Save and close the file. Restart Privoxy. The Windows firewall might prompt you to allow or deny the connection.



4 SET UP YOUR BROWSER

Now you just need to configure your laptop browser's proxy settings to redirect network traffic via Hamachi. In our example, we're using Firefox — open the Settings menu, then select 'Advanced', click 'Connection settings', scroll down to the section on proxies, and use the network address that you entered in the Privoxy configuration file, along with the port number 8118 (Image D).

The process is very similar for most web browsers, though Edge and Internet Explorer use Windows' own networking settings, so all network traffic is routed through the proxy — not just browsing traffic. You might prefer to limit it to your browser, to avoid system updates being downloaded over a slow connection. Browser extensions such as Foxy Proxy (addons.mozilla.org/en-US/firefox/addon/foxyproxy-standard) make it easy to switch between proxies, and are also worth considering for their added convenience.

Once it's configured, visit www.privoxy.org/config, and you should see a message informing you that Privoxy is enabled. If so, congratulations — you can now take your laptop away, and connect to the internet securely

via your server PC. If you don't see such a message, the issue is likely to be your firewall settings, or a conflict with an existing proxy that you've forgotten to deactivate.

5 PRIVIOXY SECURITY OPTIONS

Privoxy's default settings are fine for getting a secure connection up and running quickly, but the software is also highly customisable. Right-click its icon in the notification panel on your server PC, and select 'Edit > User Actions' to tailor its options to suit your internet use. For example, Privoxy doesn't cache cookies by default, but you can choose to override this for certain sites you visit frequently to avoid having to log in each time. You can also choose whether to exempt some sites from Privoxy's built-in ad-blocking, and filter out annoying page elements. The comments in the file are quite self-explanatory, and you can find detailed instructions at www.privoxy.org/user-manual/actions-file.html.

To be safe, it's a good idea to make a backup of any configuration files before you change them, so you can easily restore them if any of your changes prevent Privoxy from loading, or stop certain pages working, and you're not sure how to reverse the change. ■

"You might be able to tether your laptop to your phone, but most plans don't let you make wireless hotspots unless you pay an extra fee."

Other security options

Setting up your own proxy server isn't the only way to secure your browsing when you're away from home.

Another option is to use a VPN service, which does the hard work of encrypting the data and redirecting it for you. You can usually choose from a list of servers in locations around the world, which makes it a good way to avoid region-blocking.

There are some free VPNs around, but all of them have strict data transfer caps that make them impractical for anything more than checking a few emails; 100–500MB per day is the standard offering. If you travel frequently, it's worth considering a premium VPN service such as Hotspot Shield Elite, AnchorFree or TorGuard. This is the only viable option if you want to download large files or stream video over a secure connection, but it's wise to research your options carefully beforehand — some VPNs log more of their users' activity than others, and for different periods of time.

Another option is Tor Browser, which re-routes browser traffic through a network of nodes around the world, not just one server. Its main disadvantage is its slower speed. The data is decrypted at the last node, so there's a small chance that it could be intercepted at this point, but it's otherwise one of the best ways to keep your browsing private and secure.



Ryzen on a reasonable budget

Alan Dexter puts the Ryzen value proposition to work in this month's affordable build.

THE CONCEPT

It's not often we get to build a machine around a brand new architecture as we did in last month's Superguide, with the release of AMD's new Ryzen chips. That first build was an unashamedly no-compromise monster, with the top-end Ryzen 7 1800X at its heart. The problem is, that machine rolls in at over \$7,000, which puts it out of range of lots of potential system builders. To be fair, there are some liberties with

that machine on the storage and memory front, but even so, what if your pockets are not quite so cavernously deep? Can you build a decent Ryzen PC for considerably less?

Of course you can, which is why we've dedicated this month's PC Builder masterclass to the humble task of seeing what you can do with the most affordable Ryzen chip, the AMD Ryzen 7 1700. This is a mainstream machine that doesn't need a do-

anything storage subsystem, or a graphics card that costs more than some entry-level systems. It's a machine that can handle rendering, video editing and image manipulation, and even turn its hand to a bit of gaming. The kind of system that PC builders on a budget wouldn't be embarrassed to own, even if we might want something with a little more oomph from time to time.

BUILDING ON A SOLID CORE

The Ryzen 7 1700 may sit at the bottom of the current Ryzen stack, but it still boasts eight physical cores, and is capable of handling 16 threads at once — it's still designed with heavy lifting in mind. That makes it a fine bedfellow for high-end parts, but what if your needs are less demanding? Or your bank balance less gregarious? That's where this month's build comes in. We wanted a machine that would deliver where it counts, but wouldn't cost the Earth, so we've chosen components that offer good value for money, while still helping with overall performance.

One of the first choices is on the motherboard front. We've already reviewed a handful over the last two months, and the Prime X370-Pro was one of the more affordable X370 models, but it still has plenty of features on offer. Likewise, the memory landscape isn't fully formed yet, which means we don't quite know the best kits to recommend right now, so we've picked a kit that has served us well previously.

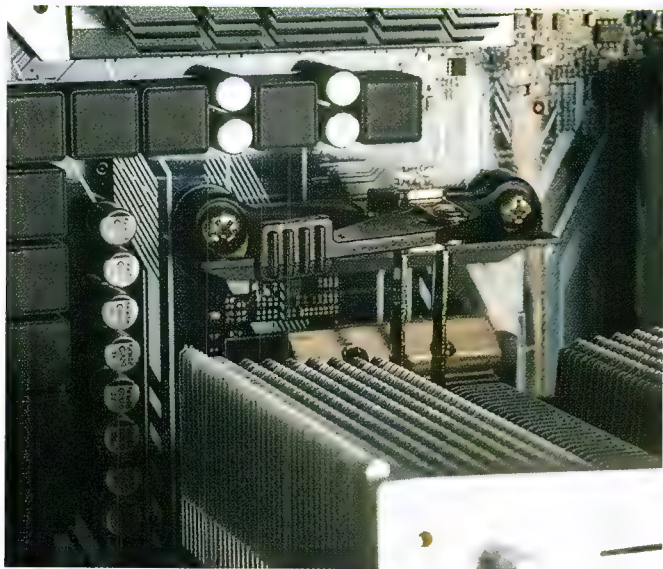
Given that we want this machine to be an all-rounder, we've opted for an ASUS RoG Strix RX 480 to provide the graphical grunt. It's a great card for 1080p gaming, with smooth frame rates in all the latest games. The fact it boasts 8GB of onboard memory means you should have room for games going forward as well.

Note that, after feedback, we now include the cost of the OS in our builds, although you're free to choose whatever OS you want.

PARTS LIST

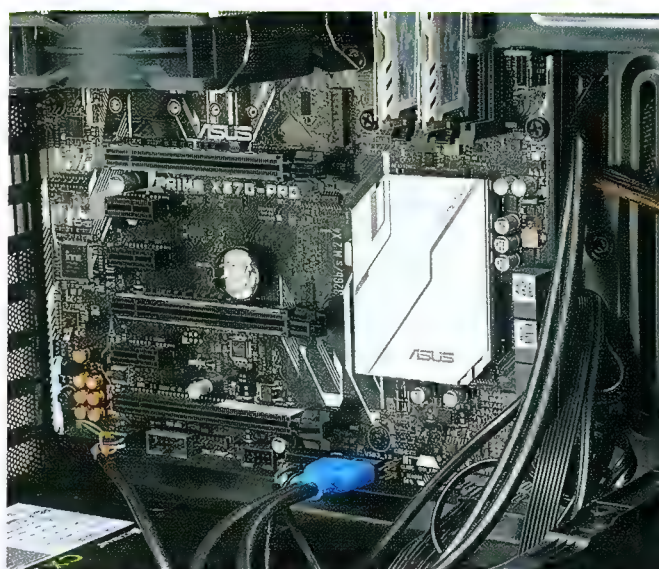
PART		STREET PRICE
CASE	ANTEC P9 WINDOW	\$129
MOTHERBOARD	ASUS PRIME X370-PRO	\$239
CPU	AMD RYZEN 7 1700	\$450
MEMORY	16GB (2X 8GB) CRUCIAL BALLISTIX SPORT LT	\$182
GPU	ASUS ROG STRIX RX 480 8GB	\$379
PSU	CORSAIR CX500	\$85
STORAGE 1	SANDISK ULTRA II 240GB	\$140
STORAGE 2	HITACHI ULTRASTAR 2TB	\$255
COOLING	BE QUIET! PURE ROCK	\$45
OS	WINDOWS 10	\$179
TOTAL		\$2,083

"Given that we want this machine to be an all-rounder, we've opted for an ASUS RoG Strix RX 480 to provide the graphical grunt. It's a great card for 1080p gaming with smooth frame rates in all the latest games. The fact it boasts 8GB of onboard memory means you should have room for games going forward as well."



1 EASY MOUNTING

Air coolers tend to be easier to install than their water-based brethren, because there isn't a radiator on rubber tubes to wrestle with. You do need to watch your fingers on the fins, though, as they have a tendency to shred your fingers in the tight confines of a case — so we recommend installing air coolers outside of the case. AMD's new chips use the AM4 socket, which boasts a similar mounting bracket to the previous generation — a bar stretches across the bottom of the cooler, which you lock into place using lugs on the brackets. Throwing the locking bar over gives you a secure cooler that's easy to release when you need to. The Be Quiet! Pure Rock even comes with a thin layer of thermal paste in place on the underside. Connect the fan, and you're good to go.

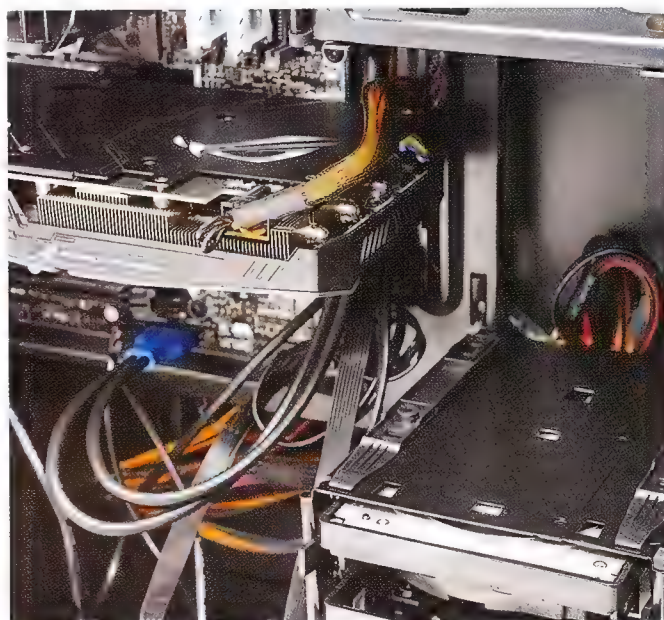


2 MOTHERBOARD POINTS

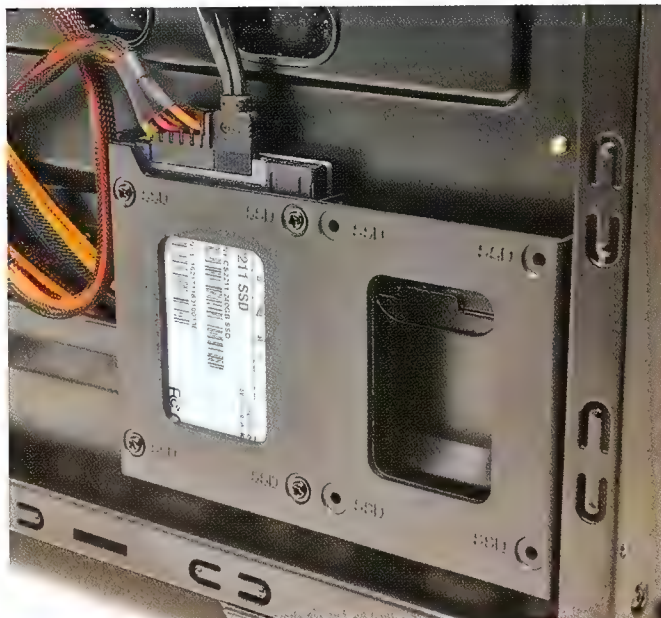
The Antec P9 is a spacious case to work in, with lots of room for routing cables. This means you don't have to install the power supply before everything else. We reached for the motherboard first, noting that the case didn't have all the mounting stand-offs installed by default — they're in a small box, with more cable ties, paper washers, plenty of screws, speaker and more cables. These are easy to screw in place, and as this is a full-sized mobo, we recommend installing them all. Don't forget to install the ATX backplate before securing the mobo, though, otherwise you'll have to unscrew everything again. Installing memory before sliding the mobo into place is good idea, but you should just have room to add/remove sticks if you have nimble fingers.



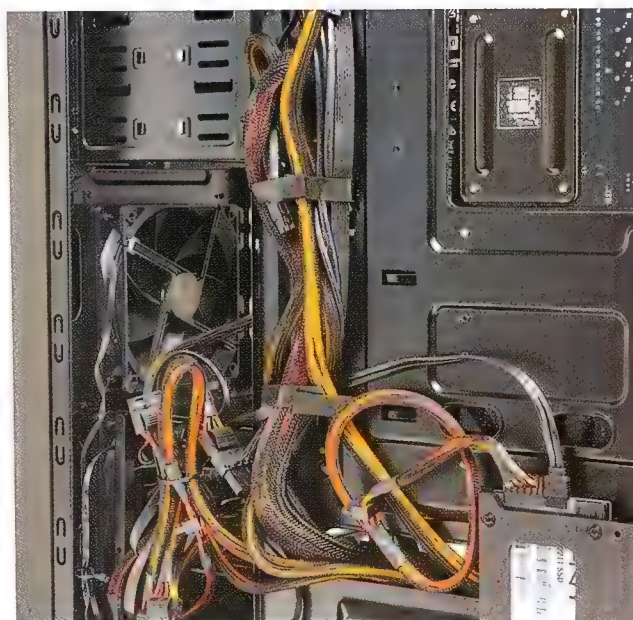
3 POWER TIME The Corsair CX500 is always a great option if you're trying to build on a tight budget, because it's a quality brand, and has plenty of power for modest builds, but still manages to roll in at a frankly ridiculous \$85. It isn't modular, which is hardly surprising at this price point, so you'll have to be creative with your cable management to keep things tidy. We installed the power supply with the fan pointing downward here, and had no problem securing it in place after applying a little pressure on top of the PSU to counter the P9's sponge strips on the PSU bracket, which are designed to help stop vibrations.



5 LONG GRAPHICS CARD There are some great deals to be had on RX 480s at the moment, and the ASUS RoG Strix RX 480 8GB is a good example of what's out there. This triple-fan card boasts higher clocks than the reference cards, but isn't noisy under pressure, which is a boon. Its length can be a problem, though, and indeed wouldn't quite fit inside the Antec P9 until we removed the middle drive bay — a ridiculously easy task that simply requires the releasing of one screw. Once removed, the card eases into place no problem, then it's simply a case of connecting the power cable.



4 REVERSE STORAGE There are plenty of options for your drives in the Antec P9, but the best place to install your SSDs is in the back of the case, in a caddy that can hold two standard SSDs. A pair of screws hold this caddy in place, which makes installation much easier than trying to screw the drives in place with it in situ. The case comes with plenty of screws, so securing our boot drive with four screws makes sense. It's worth noting that, as space is a little tight back here, you can't use angled SATA cables, because they come out further than the chassis allows at this orientation. We installed the data drive in the bottom block of cages at the front of the machine, with the cables hidden out of sight.



6 TIME TO TIDY UP All the way through this build, we routed as many cables behind the motherboard tray as humanly possible, because this helps with airflow and also keeps the machine looking tidy. It helps that the P9 has plenty of holes to make this a possibility, and there's a central column of cables that you can easily add to as you go. Having said that, there isn't that much room back there, and having a solid central bank of cables isn't possible — well, that's the excuse we're using for this not being quite as tidy as we initially hoped for. We could have used a few more cable ties on the power cables, but ultimately, it's a tidy enough build, given we were still trying out different configurations right to the end.



1 The Antec P9 Window comes with three fans installed by default — one at the rear, which covers the main processor block, and two at the front, behind the drive cages. These set up a good flow of air through the system, and we had no problems with heat.

2 We needed to remove this middle drive cage in order fit the triple-fan RX 480 in place. These cages offer tool-free brackets for up to four hard drives apiece, while the top cage can be home to up to three optical drives — again, tool-free.

3 The top of the Antec P9 Window offers a pair of USB 3.0 ports, two USB 2.0 ports, audio connectors, and sliders for easy control over your fans — another neat touch.

An affordable powerhouse

There's little doubt in our minds that the Ryzen 7 1700 is an incredible chip, and it offers some great opportunities for building systems at a number of price points and needs. Our plan was to build a system that offered strong performance, but was still reasonably priced, and to an extent, we hit that main requirement with little hassle. As we're at the start of a new family of chips, we haven't had chance to try all the different motherboard SKUs yet, and there are some questions over memory performance at this stage, so we'd expect to tweak a mainstream build like this as we find out more, but it certainly shows promise.

Before we say anything else, we'd like to call out the Antec P9 Window

for being a great case to build in. For a sub-\$150 chassis, it offers plenty of features to make life easier, and while things are cramped in the back, it's better than a lot of cases we've looked at. The tool-free drive cages work well, and removing them couldn't be any easier, should you need to make room for a longer graphics card.

On to performance. Normally, we compare our monthly build with our main APC Labs test system, but that machine costs considerably more than this system, so we've instead compared it to last month's build, which was based on AMD's FX-8370, and rolled in at not much less than this.

The differences are impressive, and show just how far AMD has managed

to come with Ryzen compared to the outgoing Bulldozer architecture. The Cinebench R15 scores clearly show the advances: The multi-threaded score is to be expected when you're going from an 8-thread chip to one with 16 threads, but it's the single-thread performance that really stands out. That 61% improvement shows that this is a significantly different core.

The gaming scores aren't as straightforward to interpret, as we're going from a last-gen GTX 960 with 2GB of RAM to a current-generation RX 480 with 8GB of RAM, which costs about \$80 more. Still, the differences are stark and, in many cases, represent a shift from having to dial down settings in order to hit smooth frame rates, to being smooth off the bat. In real terms, you may have to ease back on some settings on newer releases, but this is a machine that will last some time — and if you're serious about gaming, a faster graphics card makes for a wise investment.

Overall, we've enjoyed building this machine, and we're happy with the end result. That hasn't stopped us looking forward to seeing what the rest of the Ryzen family serves up, though — our Ryzen 5 review chip arrived just a little too late to be dropped into this build, but we'll definitely use it in future, and Ryzen 3 should drop later in the year. We're also intrigued to see what the first Ryzen APUs dish up. ■

BENCHMARK RESULTS

	APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI-THREAD	532	1,401 (163%)
CINEBENCH R15 SINGLE-THREAD	90	145 (61%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	536	560 (4%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	514	456 (-11%)
DEUS EX: MANKIND DIVIDED (FPS)	15	26 (73%)
RISE OF THE TOMB RAIDER (FPS)	26	38 (46%)
FAR CRY PRIMAL (FPS)	35	61 (74%)
ATTILA: TOTAL WAR (FPS)	20	29 (45%)

Our comparison PC this month uses an AMD FX-8370, an ASUS GeForce GTX 960 2GB and 16GB of RAM. All games are tested at 1080p on max settings, with HD texture packages installed.

Run a WordPress-powered site from a Raspberry Pi

Sean Conway demonstrates how to install the three software foundations — web server, database and language — for a CMS web server.

This tutorial will configure a Raspberry Pi as a web server to set up a content management system (CMS) using the popular WordPress platform. Before starting the configuration, we'll cover what makes a CMS and follow up with how to install and configure a WordPress server and have it running and accessible from a browser. For this tutorial, you'll need a Raspberry Pi for booting into Raspbian. You'll also need some experience using the terminal and be comfortable using a text editor to work with files.

Drupal, WordPress and Joomla are just three examples of free open-source CMS software platforms available. Drupal came to life as an open-source project in 2001 while WordPress first appeared in 2003. Joomla was a software fork of Mambo in 2005. Each has something that makes their CMS successful but we're going to use WordPress.

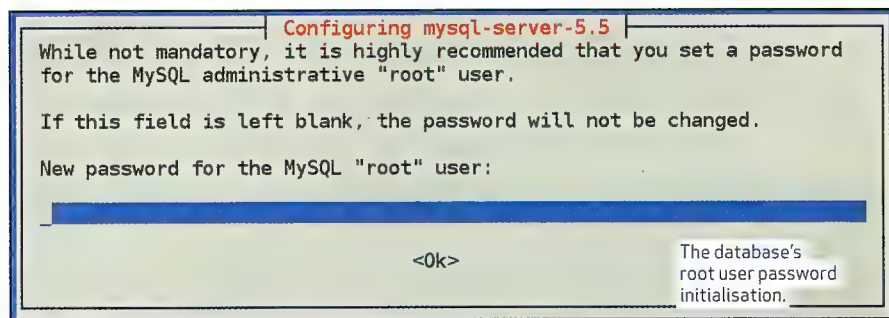
CMSPI

A Raspberry Pi with Ethernet network capability provides a simple yet ideal platform to experiment with a CMS. To run our WordPress CMS web server, we used a Model B Revision 2.0 running Raspbian (Wheezy) which you can download from www.raspbian.org and load onto a 4GB SDHC memory card. Other Pi models and Linux distros will work, but before we start, we need to run through the boxout. (See 'The usual updates', top right.)

Now let's begin by adding the three software components that establish a LAMP (Linux Apache MySQL PHP) server.

```
sudo apt-get install -y nginx
mysql-server php5-fpm php5-cli
php5-gd php5-mysql
```

This line of code installs the web server (`nginx`), relation database (`mysql-server`) and programming language PHP (`php5-fpm php5-cli php5-gd php5-mysql`) of the LAMP server. For this tutorial, we've replaced the 'A' for Apache in LAMP with Nginx, which is a simpler web server to configure. Also note, the PHP installation contains packages to



support CGI scripts, command-line interface, graphics and communicate with our relational database.

During the installation of the MySQL relational database, the installation process will stop and display a screen that asks for a password. This password is for the database superuser account (i.e. root under MySQL). This account has god-like privileges on the database, so apply some forethought in creating a secure password for this database access account.

When the software installation process completes, the command prompt will return. Initiate a reboot (i.e. `sudo shutdown -r now`) to ensure the Pi comes back up after the software installations. Log in again and open a terminal window to proceed with configuring the software.

During configuration of the software, a number of different accounts will be used for specific tasks, which can get confusing for a novice because some accounts have the same names. One of the goals of this Pi tutorial is to assist the reader in understanding the different accounts that are used during configuration.

A user accesses (i.e. logs in) Raspbian with user account credentials. In the case of a Raspberry Pi, the credentials are username: 'pi', with a default password: 'raspberrypi'. Software applications running on the OS also use credentials. For instance, the web server has an account username: 'www-data', and the relational database MySQL has an account username: 'mysql'.

When software is running and accessing system resources they are functioning under their OS user account name, which is similar to a

user's account used to log in to access files. Typically, the accounts for the software components are prevented from logging into the system.

RELATIONAL DATABASE

Within the relation database software itself, there are additional accounts. The accounts used within the database provide control to manage and access the database resources (i.e. databases and tables, and so on). The relational database is built containing an account called 'root'. This root account is for the MySQL software and is separate from the root account for the OS.

Starting off first in the LAMP configuration batting order is the database. From the command line, open the MySQL relational database console using the software root user (`-u`) account: `mysql -u root -p`. The application will ask for the password (`-p`) that you have assigned during the software installation. From the MySQL command prompt (as in: `mysql>`) issue the following command: `show databases ;`. Commands entered in the MySQL console must end with a semi-colon to be recognised. The output from the command will show the databases that currently exists (see the grab bottom right).

```
create database wpDB;
create user wpdbprime@
localhost identified by
"WordPressDB";
grant all privileges on
wpDB.* to wpdbprime@localhost;
flush privileges;
```

The database names displayed are the databases the application itself uses to


```
mysql> show databases;
+-----+
| Database |
+-----+
| information_schema |
| mysql |
| performance_schema |
+-----+
3 rows in set (0.00 sec)

mysql>
```

The default databases that make up MySQL.

store information. Next, we use the database root user account to create a new database for the exclusive use of the CMS. Finally, we'll also create a user account that has the permission necessary to manage the new database.

Let's do a quick recap. First, a command was issued inside the database console to create a database with the name 'wpDB'. Next, we have a command to create a database user to access the database from the localhost with the user name 'wpdbprime' and password 'WordPressDB'. The next command assigns all privileges required to manage the database named 'wpDB' to the database user 'wpdbprime'. The last command we use enables the permissions to take effect.

To confirm that the tasks were completed, we issue the following commands and examine the outputs:

```
show databases;
```

The output should show that the name of the new database has been created.

```
use mysql;
```

We can also examine the database that holds the data for the databases with...

```
select user,host, password
from user;
```

And see that, yes, both the user account and the password are encrypted.

```
exit;
```

We're partial to an OS reboot and an APC Cup of Tea™ at this time. However, it could be argued, that it's not required [NO TEA?! – Ed] because the changes were all contained within a resident application and not to the OS; therefore, a reboot is not necessary – but we like a cup of tea.

The usual updates

Before loading the software components, it is good practice to ensure that the distro is updated, so it has all the newest versions of all packages currently installed on the system from the source repo:

```
sudo apt-get update
sudo apt-get upgrade
sudo shutdown -r now
```

The upgrade command is used to install the newest versions of all packages that are currently installed on the Pi. An `update` command is performed first so that `apt-get` knows if new versions of packages are available. Restarting an OS after major changes will help in the long run. It makes troubleshooting problems easier. Performing a number of tasks on an OS before rebooting creates the difficulty of trying to determine what change may have caused the error.

Now that the database setup is complete, let's tackle the web server. The directory `/etc/nginx` is the location for the configuration files used by Nginx. Using your favourite text editor, create a file in the directory specified and add the contents shown. We're old school and haven't stopped to learn some of the improved text editors, so we bang out text files using legacy 'vi' using the filename: 'wordpress' and the directory: `/etc/nginx/sites-available/`.

```
server {
    server_name webpi;
    listen 80;

    root /home/pi/www/
    wordpress;
    index index.php index.html;

    location / {
        try_files $uri $uri/ /
        index.php?$args;
    }

    location ~ .php$ {
        try_files $uri /index.
        php;
        include fastcgi_params;
        fastcgi_pass unix:/var/
        run/php5-fpm.sock;
        fastcgi_param SCRIPT_
        FILENAME $document_
        root$fastcgi_script_name;
    }
}
```

```
fastcgi_index index.php;
}
}
```

WEB SERVER

Let's examine the lines of code (above). The first set of parenthesis defines the web server's name and what port it should be listening on (i.e. port 80). The next section defines where the root of the web server file system starts and what file or files you should find there by default if nothing else is specified. The last set of parenthesis are configuration options to tailor the use of PHP scripts.

Whatever name you chose to put in the `server_name` file edit the `/etc/hosts` file and add the IP address and hostname (or `server_name`) details at the top of the file. In this tutorial, it was 192.168.2.104 webpi. The file will already contain a reference to the hostname that points to 127.0.1.1 (127.0.1.1 webpi). Remove the entry and save.

The next series of commands will remove the web server default configuration file and enable the new web server configuration. A restart of the web server ends the series:

```
sudo rm /etc/nginx/sites-
enabled/default
sudo ln -s /etc/nginx/sites-
```

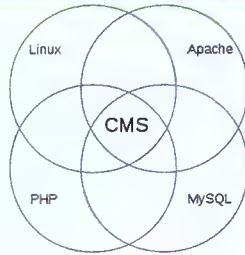
```
mysql> use mysql;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select user,host, password from user;
+-----+-----+-----+
| user | host | password |
+-----+-----+-----+
| root | localhost | *A9D467528C52CF9DD63A2168DBE51A8241160241 |
| root | webpi | *A9D467528C52CF9DD63A2168DBE51A8241160241 |
| root | 127.0.0.1 | *A9D467528C52CF9DD63A2168DBE51A8241160241 |
| root | ::1 | *A9D467528C52CF9DD63A2168DBE51A8241160241 |
| debian-sys-maint | localhost | *65881B070D7D9546B5C0B6EB1B4DBB85621D8CC0 |
| wpdbprime | localhost | *F3DEFFA4FF732EA76F8169BCE1E8B5095D99313C |
+-----+-----+-----+
```

The new wpdbprime user and password can be seen in the mysql database.

The fantastic four of CMS

LAMP, the fantastic four of the open-source server setup: Linux distro, Apache web server, MySQL relational database and PHP programming language work together to deliver the genius of a CMS. WordPress is a PHP script package that melds the web server with a relational database to provide the functions found in a CMS.



How LAMP forms a CMS.

```
available/wordpress /etc/nginx/
sites-enabled/wordpress
sudo service nginx restart
```

With the web server restarted, let's use a few commands to see under the hood. The web server will have a process associated with it and there will be a port open (i.e. LISTEN) for the web service to use.

```
sudo ps -ef|grep nginx
sudo lsof -i:80
sudo netstat -an|more
```

The terminal window screenshot (see, below) shows the output from the three CLI commands that show there is a web server running. The first command displays the web server master process started by the operating system root and then the worker process owned by www-data. You recall this is the OS account used by the web server.

In the output of the next command, notice the worker processes are listening on a TCP port for HTTP, the web service protocol. If you're not sure what services are associated with what ports, use a text editor to examine the /etc/services. Never again, will you need to remember port numbers!

In the last command output, you can see the web service port 80 is listening.

If you aren't convinced, issue the command to stop the Nginx service (i.e. replace **restart** in the service command with **stop**) and run the same series of commands again and examine the output.

From the last command output, take note there's a port 3306 in LISTEN. Venture to guess what software installed so far would be listening for a connection? The /etc/service file is one place to look. If your response was MySQL, you would be right. You may recall it was configured just before we did the web server.

A final test for the web server is to use your browser to connect to the web server using the IP address assigned to the server. The browser should display an error page generated by the web server. The web server throws up an error because it cannot find the directory specified in its configuration file.

That is two software components: relational database and web server installed for a CMS. Next, we'll supply the WordPress content that the web server is looking for.

You may recall the first part of setting up a LAMP server was installing the PHP applications. But what about WordPress? In the web server configuration, a root directory and file

were specified. Let's create that directory and camp out in it, to load and configure WordPress:

```
sudo mkdir /home/pi/www && cd
/home/pi/www/
```

The WordPress website holds a repo (repository) of the most current build of the file package. Download the file and unzip it to deposit the contents in the web server's home directory:

```
sudo wget https://wordpress-
org/latest.zip
sudo unzip latest.zip
```

PHP/WORDPRESS

To fine tune the configuration, it's necessary to establish ownership and permission to the WordPress directories. The WordPress ZIP package was downloaded and installed using the pi user account using **sudo** for root access. For that reason, all the directories and files belong to the owner root and the group root.

The web server needs access to the directories and files of the WordPress installation. The web server has its own group www-data and owner www-data. Looking back at the command that displayed the worker process for the web server, notice that OS root starts the Nginx service but it then spawns ownership of the process to the web server owner, www-data — this is all part of an elaborate plot to ensure a secure system.

```
sudo chown -R pi:www-data /
home/pi/www/wordpress/
sudo find /home/pi/www/
wordpress/ -type d -exec chmod
755 {} \;
sudo find /home/pi/www/
wordpress/ -type f -exec chmod
644 {} \;
sudo chmod -R 775 /home/pi/
www/wordpress/wp-content
```

When the website setup is complete, it's necessary to reset the wp-content directory to ensure everything is locked down and not open for others to change. To do so enter the following command and follow the walkthrough (opposite):

```
sudo chmod -R 755 /home/pi/
www/wordpress/wp-content
```

There you have it: a pocket size, portable WordPress server. Remember: if you decide to take your development system to a different network, there's a good chance DHCP will supply an IP address that wasn't used during configuration. A quick edit of the Pi /etc/hosts file is all that is required to have your web server up and accessible!

```
pi@webpi ~ $ ps -ef|grep nginx
root      8883      1    0 11:06 ?        00:00:00 nginx: mas
www-data  8884    8883    0 11:06 ?        00:00:00 nginx: worl
www-data  8885    8883    0 11:06 ?        00:00:00 nginx: worl
www-data  8886    8883    0 11:06 ?        00:00:00 nginx: worl
www-data  8887    8883    0 11:06 ?        00:00:00 nginx: worl
pi        8889   2356    0 11:07 pts/0    00:00:00 grep --col

pi@webpi ~ $ sudo lsof -i:80
COMMAND  PID  USER  FD  TYPE  DEVICE  SIZE/OFF  NODE  NAME
nginx    8883  root   6u   IPv4  19540      0t0    TCP  *:h
nginx    8884  www-data 6u   IPv4  19540      0t0    TCP  *:h
nginx    8885  www-data 6u   IPv4  19540      0t0    TCP  *:h
nginx    8886  www-data 6u   IPv4  19540      0t0    TCP  *:h
nginx    8887  www-data 6u   IPv4  19540      0t0    TCP  *:h

pi@webpi ~ $ netstat -an|more
A Our web server
P account with worker
t process, protocols
t and ports all set
t to LISTEN.

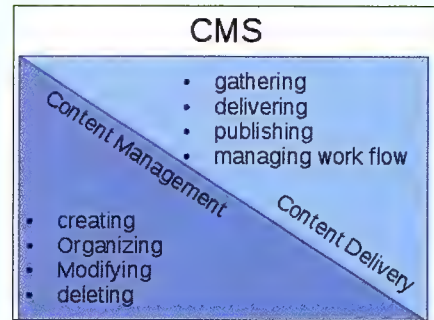
Send-Q Local Address           Foreign Address         State
tcp        0      0 0.0.0.0:80                0.0.0.0:*               LISTEN
```


In the beginning...

In the early days of website development, the emphasis was on designing the web pages around the content. The site content was hard coded in HTML. Supporting the server required comprehensive webmaster skills. The development of content management systems (CMSes) changed website design by separating the content from the page code. In a CMS, the web pages are fed content instead of being embedded in the code, which

enables the content to be managed with minimal skills.

An effective method for understanding a CMS is to divide it into two subsystems: one is content management. The components used in the management subsystem enable creating, organising, modifying and deleting website content. The other subsystem is content gathering that publishes content to the web and manages workflow.



Configuring and install WordPress

Welcome to WordPress. Before getting started, we need some information on the database. You will need to know the following items before proceeding:

1. Database name
2. Database username
3. Database password
4. Database host
5. Table prefix (if you want to run more than one WordPress in a single database)

We're going to use this information to create a `wp-config.php` file. If for any reason this automatic file creation doesn't work, don't worry. All this does is fill in the database information to a configuration file. You may also simply open `wp-config-sample.php` in a text editor, fill in your information, and save it as `wp-config.php`. Need more help? [Woo woo!](#)

In all likelihood, these items were supplied to you by your Web Host. If you don't have this information, then you will need to contact them before you can continue. If you're all ready

Let's go!

Below you should enter your database connection details. If you're not sure about these, contact your host.

Database Name	wpdb	The name of the database you want to run WP in
User Name	wpdbprime	Your MySQL username
Password	WordPressDB	...and your MySQL password
Database Host	localhost	You should be able to get this info from your web host. If localhost doesn't work
Table Prefix	wp_	If you want to run multiple WordPress installations in a single database, change this

Submit

Sorry, but I can't write the `wp-config.php` file.

You can create the `wp-config.php` manually and paste the following text into it:

```
1. Copying
2. Visit the codes
3. link: https://codex.wordpress.org/Debugging_in_WordPress
4.
5. define('WP_DEBUG', false);
6.
7. That's all, stop editing! Happy blogging.
8.
9. Absolute path to the WordPress directory.
10. If (defined('ABSPATH')) {
11.     define('ABSPATH', dirname(__FILE__) . '/');
12. }
13.
14. Sets up WordPress vars and included files.
15. require_once(ABSPATH . 'wp-settings.php');
```

1 REBOOT YOUR SERVER
Kick off a reboot of the server, by now, you must remember the `shutdown` command for a restart. When the server returns, open a web browser to access the user front-end of the CMS system by entering the URL <http://webpi>. The WordPress platform is designed to provide step-by-step assistance in completing the configuration. We are in the home stretch now, select the 'Let's Go' radio button and proceed.

2 GENERATE YOUR CONFIG
Fill in the question fields with the configuration data used for setting up the MySQL database. If you don't recall them, the details are in the screenshot (above). After completing the fields, select the 'Submit' button. Using the details provided, WordPress generates the contents for the configuration file `/home/pi/www/wp-config.php`. It wouldn't be able to write the contents to a file so it will stop and ask for assistance.

3 CREATE ADMIN ACCOUNT
Create the file listed above using the CLI. Copy the contents from the screen and deposit them to the file. When the file is saved, go back to the web screen and select the button to run the install. WordPress will return a welcome screen. The details for this screen are needed to create an account that can log into the web server admin front-end and make web design configuration changes in the back-end.

Welcome

Welcome to the famous five-minute WordPress installation process! Just fill in the information below and you'll be on your way to using the most extendable and powerful personal publishing platform in the world.

Information needed

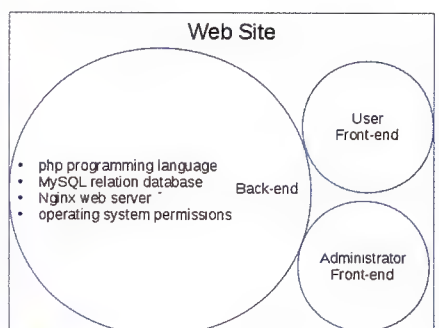
Please provide the following information. Don't worry, you can always change these settings later.

Site Title	Hello WordPress World
Username	wpadmin
Password	wordpressWEB

Success!

WordPress has been installed. Were you expecting more s

Username wpadmin



4 INSTALL WORDPRESS
The first question asks to create a title for the website. Use the details from the screenshot to complete the form to put the final touches to the CMS config. Select 'Install WordPress' button on the bottom of the screen. The success screen will appear in a short while. You can't log in on the success screen, even if it looks like you can. To log in drop the URL <http://webpi/wp-admin> into your browser.

5 DESIGN YOUR SITE
Now use the credentials you've created (wpadmin) to log in and start designing a CMS website using WordPress. Access the user content published by the web server via a browser. The configuration tools for WordPress are also available via a web browser. The CMS site is built to display the content to browser users by sourcing content data from a relational database.

6 CONTENT FLOW
Content is displayed by publishing to the web server's front-end (<http://webpi>). In the back-end of the web server, there are many components working together to publish the content. The configuration of the website is controlled by an administrator accessing the back-end functions via the web server administrator front-end (<http://webpi/wp-admin>). ■

Preview releases of Android O are now available to developers.

Android O Developer Preview

An early look at the next version of Android for testing, development, and feedback. Get your apps ready for Android O!

GET STARTED



Get hands on with Android O

The next version of Android is coming. Darren Yates explores the new features and how you can get hold of an early OS preview code right now.

It's that time of year again when speculation grows over the next release of everyone's favourite mobile OS, as early "developer previews" of Android O begin to drop. While nothing is ever definite until the final release hits the airwaves and new devices land on store shelves, we round up the new major features as they are and delve into some of the big-ticket items coming your way.

WIRELESS AUDIO IMPROVEMENTS

Apple's AirPods may have brought Bluetooth-enabled earphones to the mainstream, but it looks like Android O could potentially outplay the AirPods for quality, thanks to tech from Japanese giant Sony. Sony's LDAC

wireless audio format has been available exclusively in its Xperia X and Z-series phones for the last year or so, but it's now Sony's contribution to Android O and reportedly available to any Android device manufacturer to implement free-of-charge through the Android Open-Source Project (AOSP).

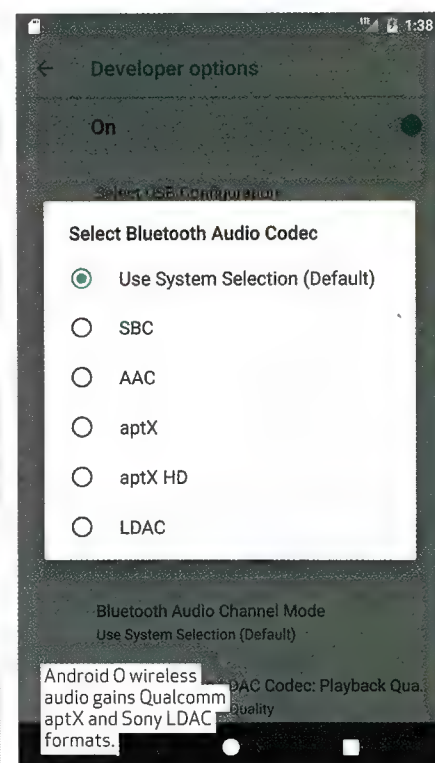
While Sony never seems to detail exactly what 'LDAC' stands for, the company claims it delivers up to 96kHz/24-bit stereo audio over Bluetooth using a much higher transmission rate. Bluetooth's basic A2DP (advanced audio distribution profile) has been around for years, hitting a top speed of 328Kbps when transmitting CD-rate (44.1kHz/16-bit) audio. But A2DP also requires lossy sub-band coding (SBC) audio compression to reduce the 1.411Mbps CD-audio data rate to transmissible levels. By contrast, LDAC offers three transmission rates – 330Kbps, 660Kbps and 990Kbps. It's this top 990Kbps rate that apparently allows 96kHz/24-bit (4.5Mbps) stereo audio to go in at one end and 96kHz/24-bit (4.5Mbps) stereo audio to come out the other, at least according to one graphic on Sony's LDAC microsite (tinyurl.com/mqchl94).

This has led to questions over whether or not LDAC is a 'lossless' codec. The problem is, the best compression level lossless audio codecs can achieve right now is around 55%, so unless Sony has made a major breakthrough, there's no way you can squeeze 4.6Mbps of audio into 990Kbps of bandwidth and not lose something on the way. To be fair, Sony's microsite is careful not to suggest the resulting output is 'high-res audio', rather calling it "higher-quality sound". Still, the results should

be pretty decent, and certainly better than standard A2DP, simply from having up to three times the A2DP bandwidth to play with.

At time of writing, the 'libldac' source code was available on Google's Android source site (tinyurl.com/lf322u6). You'll need LDAC-ready wireless headphones to make use of the wireless audio format, such as Sony's noise-cancelling MDR-1000X.

However, LDAC isn't the only new Bluetooth audio addition on offer in Android O, with Qualcomm's aptX



Version	Codename	API	Distribution
2.3.3 - 2.3.7	Gingerbread	10	0.9%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	0.9%
4.1.x	Jelly Bean	16	3.5%
4.2.x		17	5.1%
4.3		18	1.5%
4.4	KitKat	19	20.0%
5.0	Lollipop	21	9.0%
5.1		22	23.0%
6.0	Marshmallow	23	31.2%
7.0	Nougat	24	4.5%
7.1		25	0.4%

Less than 5% of devices are running Nougat/Android 7.x as of April 3.

and aptX HD formats also getting a run. Qualcomm bought aptX maker CSR in 2015 and the wireless audio format has since appeared in dedicated audio devices, as well as the Samsung Galaxy S8 and LG G6 phones.

PICTURE-IN-PICTURE MODE

It's already available on Android TV and now Picture-in-Picture (PIP) comes to other devices via Android O (tinyurl.com/jwmnmxp). This means that an app in PIP mode will continue to playback content in the PIP frame, while you work on the current app. However, we think the way its implemented might cause a hiccup or two at the start for developers. Google says an app in PIP mode is in a 'paused' state, but that 'pause' shouldn't include media playback. Instead, content playback should only be paused in 'onStop()' mode and resumed in 'onStart()' mode. So effectively, you still play in 'pause', then pause in 'stop'.

In any event, it only works in apps coded with PIP support – this you do by first setting 'android:supportsPictureInPicture' as 'true' in the app's Android Manifest file, then incorporating the relevant application programming interface (API) code into your app screens or 'activities'.

MULTI-DISPLAY SUPPORT

Android has been making moves towards the desktop environment in recent times, not just thanks to custom releases such as RemixOS (tinyurl.com/gr6jha8), but also through Nougat's Multi-Window option. Android O takes this a step further with multi-display

LG's new G6 could be in line for an Android O update toward the end of 2017.



support. According to Google, users running Android O devices with multiple displays will be able to move an activity from one display device to another. However, the app will, again, need to be enabled for multi-display, otherwise it won't be going anywhere.

Also, if you use adb shell, Google says you can now launch an activity and set the display it runs on using the command:

```
adb shell start <activity_name> --display <display_id>
```

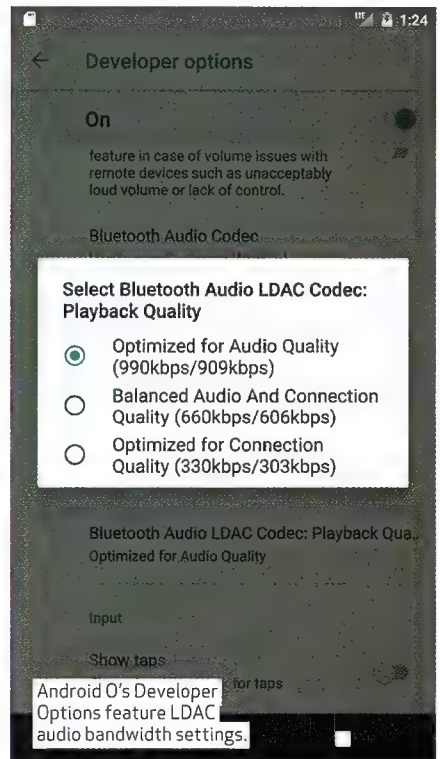
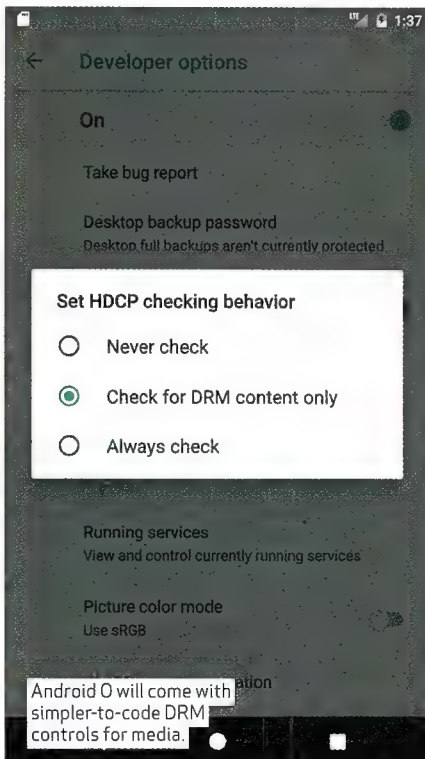
Android Debug Bridge (ADB) was originally included in the Android software development kit (SDK), but earlier this year, Google released it as

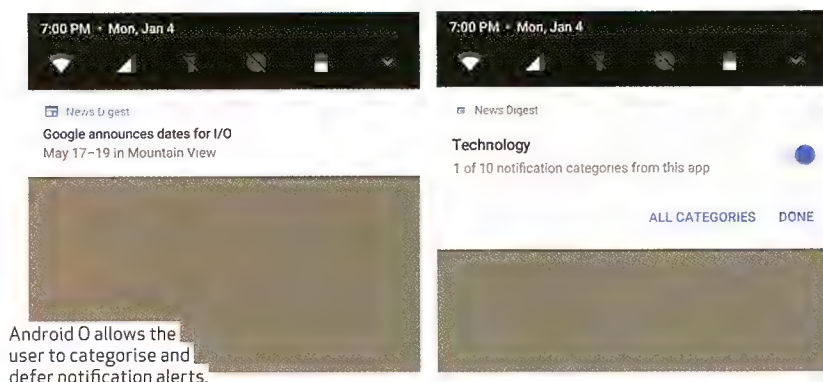
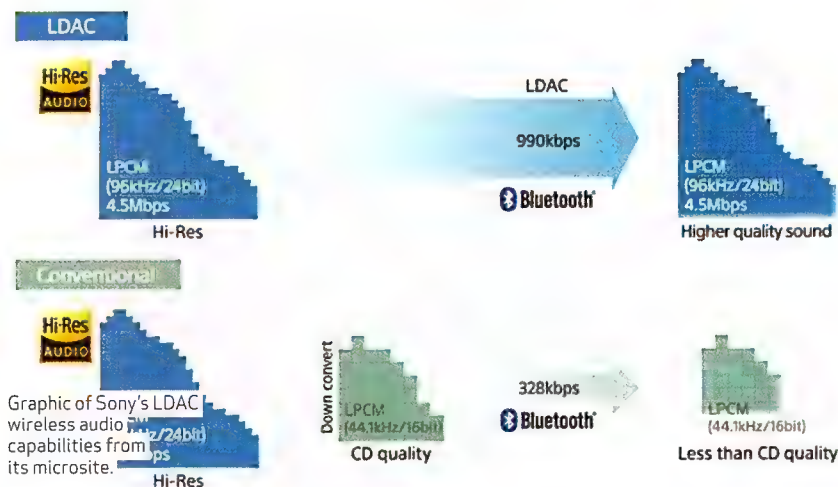
part of a separate, much smaller 3.5MB download called 'SDK Platform Tools' available from tinyurl.com/jhy47m.

WI-FI AWARE

Transferring data from one mobile device to another is big business – you already have near-field communications (NFC) for low-dose data, including the booming array of wireless payment services. Now, Wi-Fi is the centre of renewed focus.

Wi-Fi Aware (tinyurl.com/p2myjur) is the public face of Neighbour Awareness Networking (NAN), a new-ish Wi-Fi standard that's been kicking around since 2015 and allows Wi-Fi Aware devices to discover each other and connect without an access-point.





makeover, providing the user greater control in how and when they appear. The changes include a new 'snooze' option that defers notifications until a more convenient time. They still appear with the same importance level, but you get to choose when.

Developers can also set a timeout for notifications, thanks to a new Java method called 'Notification.Builder.setTimeout()'. This will set the time, after which, a notification is automatically cancelled. Android O will also support changing the background colour to indicate particular notifications. Google says this could be used for setting driving directions or a phone call in progress (tinyurl.com/kmq4ko).

BLOCKING RANSOMWARE

Other less visible features in Android O include changes that could protect against some ransomware apps. Ransomware, malware apps that encrypt a device and demand money for the unlock key, aren't that common in Android, but Google appears to be closing off at least one attack vector in new 'O'.

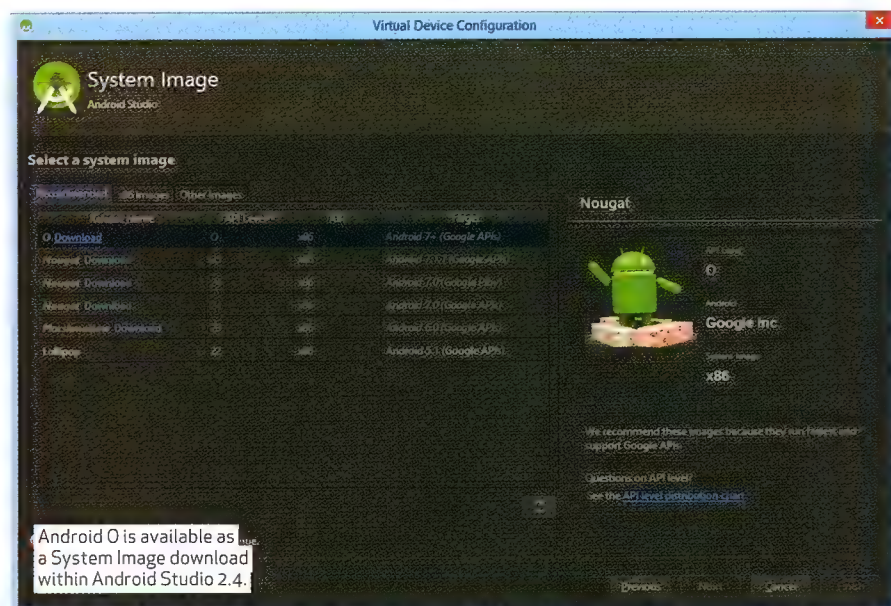
The changes were identified by Symantec (tinyurl.com/ll23v6r), finding Google had disabled or 'deprecated' a number of 'TYPE_SYSTEM' window options. TYPE_SYSTEM windows appear on top of all other applications, as in the case of important alerts. However, ransomware coders have used these windows to lock-down a device and force the user into ransom payments.

Google has not only removed three such TYPE_SYSTEM options from Android O, it's given users the ability to pull down the systems settings page over the top of system-style screens and turn off any rogue app. Unfortunately, this won't help devices stuck on Nougat or older Android releases, nor will it stop other ransomware apps using other attack vectors. But still, it can't hurt.

NEW MEDIA FEATURES

Aside from new Bluetooth audio enhancements, Google is also tweaking its major media functions or 'classes', MediaPlayer and MediaRecorder. MediaPlayer gets improved seek control, now allowing you to seek to a time position in a video file right down to the nearest frame, not just the closest key frame. It also provides simpler tools for developers to playback media with digital rights management (DRM) protection (although fewer will be excited by that, we're sure).

More interesting are the changes coming to MediaRecorder. For starters, you'll now be able to record H.264 video and AAC audio into MPEG2-TS, the streaming file format used by broadcast TV networks. Expect to also see more advanced AV editor apps, thanks to the removal of Android's one audio/one video track limit. The 'MediaMuxer()' class now



Sony's MDR-1000X headphones support LDAC wireless audio.



accepts any number of audio and video tracks, as hardware allows.

REDUCING BACKGROUND HOGGING

Smartphones aren't far off laptops and PCs in terms of hardware resources, particularly RAM, but you still only need a few misbehaving apps running in the background, hogging RAM or CPU cycles, for your phone to start feeling sluggish. Android O will now impose limits on apps running in the background – essentially, any app not meeting Android's definition of 'foreground' (for example, an important service function or activity visible to the user) will be classed as 'background'. It'll have a few minutes to continue doing 'foreground' tasks, but after that, it'll be considered 'idle' and, in all but a few cases, the OS will halt the app's background services.

There are work-arounds, but this move only affects apps designed for or 'targeting' Android O (currently API Level 'O'). If you're an app developer and you target any lower API level, your apps won't be affected, even if they're running on an Android O device.

MORE ART SPEED

Google has been on the charge for extra performance for a while, offering up different combinations of its run-time

code engines in recent Android releases. For example, Nougat/Android 7.x brought back Dalvik-like Just-In-Time (JIT) compilation in combination with Android Run-Time (ART) for extra zip. This time, the Android devs believe 'O' can crank out even more speed, reportedly achieving as much as twice the performance on some benchmarks. We'll wait until we see final code before testing it.

TRYING OUT THE PREVIEW

According to Google's timeline, that final code is expected to be released sometime in 'Q3' (August–October) this year. In the meantime, Developer Preview 2 (DP2) should hit mid-May and DP3 in mid-June, by which time, all APIs will be locked down. DP4 will then land by mid-July, just ahead of the official launch.

If you're into extreme sports and don't want to wait until August, you can try your hand at Android O right now with a Developer Preview. At time of writing, DP1 was available for a range of Google devices, including the Nexus 5X, 6P and Pixel, plus the Pixel C and Pixel XL. An early Android O software development kit (SDK) is also available via the Android Studio 2.4 Preview 'Canary' (alpha) integrated development environment (IDE), along with an

Android O emulator, through the AVD Manager (tinyurl.com/pj3sovs).

Just make sure that if you do try DP1 on actual hardware, know first how to revert back to the previous OS – being the first preview, it's meant for developers only and not intended for everyday use.

WILL MY DEVICE GET 'O'?

Despite all the new features, this is the question most users are really interested in. Our golden rule-of-thumb when it comes to Android updates is 'never hold your breath'. The stream of previous Android releases still in the wild reads like a comet's tail, a continuing sign that more devices miss out on updates than those receiving them.

Less than 5% of all Android devices accessing the Google Play website in the week ending April 3 were running Nougat/Android 7.x. More than 60% of all devices were still on Lollipop/5.x or older. However, given Lollipop/5.0 arrived back in November 2014, it's possible this year could see renewed interest in new Android devices as two-year telco contracts expire.

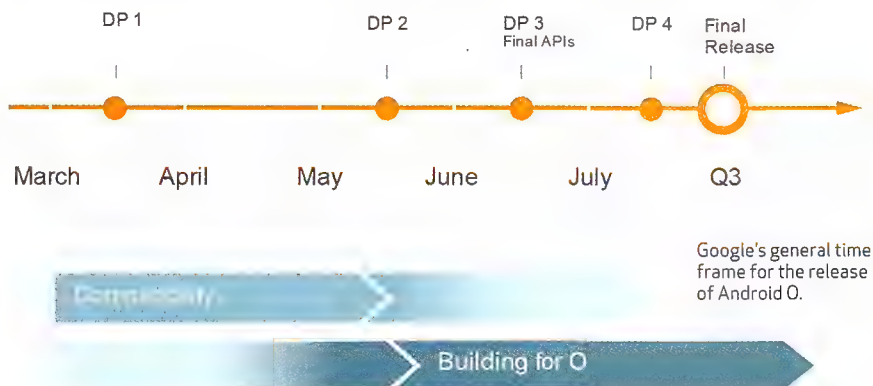
But bottom-line, if your device isn't already running Nougat/7.x, we don't hold out much hope of an Android O update. For Marshmallow/6.x devices, your best bet will likely be custom/community ROMs sometime after the final AOSP release drops (just be aware of the risks custom ROMs can present).

Of course, there are always exceptions to every rule. The long-lived Samsung Galaxy S3, for example, simply refuses to die, with LineageOS custom Nougat/7.x updates currently available on a 'nightly' basis. But on the other hand, if you have a two-year-old \$99 online vanilla 'special', we'd probably just put it down and walk away.

In the end, though, the whole update question could end up much simpler to decipher – if your device doesn't have the supporting hardware for features like LDAC or aptX, device manufacturers may just skip the update idea, regardless of the OS its running.

MORE TO COME

All of these features (and more) add up to another evolutionary step in the Android journey. The improvements to Bluetooth audio are likely to be the standout selling points, but Google still has some time before final feature lock-down, so there may be more to see yet. What will be equally as interesting to see are the new devices coming for Android O, but we'll have a while to wait yet for those. ■



Build a Wi-Fi internet clock – Part 1

Darren Yates introduces a new microcontroller board with built-in Wi-Fi and shows how to make a Wi-Fi clock using Network Time Protocol in this two-part mini-series.

The ESP8266 Wi-Fi module from Espressif Systems has revolutionised the maker community and made it possible to build and code your own Internet of Things (IoT) gadgets with comparative ease. We've covered this module previously in APC, connecting it to an Arduino Uno.

However, the ESP8266 market has matured since then and you can now not only purchased dedicated ESP8266 Wi-Fi development boards from around \$5, you can also program them directly from the Arduino IDE, no Arduino board required.

NODEMCU DEV KIT

Among the raft of ESP8266 modules, the NodeMCU Development Kit is one of the most popular, combining full Arduino IDE connectivity via MicroUSB port with code access to the ESP8266 internal chip architecture. The ESP8266 is a full-stack 802.11b/g/n Wi-Fi module, powered by an 80MHz Tensilica LX106 32-bit microcontroller, 80KB of RAM and up to 4MB of flash storage. You'll find them on eBay for around \$5.

SETTING UP THE IDE

We've got too much to cover for just a single story this month, so we're covering the basics of getting the NodeMCU board up and running in the Arduino IDE this issue, and looking at

the details of how to build the clock next month.

As you may have guessed, the NodeMCU is not an official Arduino board and it's really thanks to the open-source community that this chip can now be coded and flashed directly using the Arduino IDE. However, the IDE itself knows nothing of the ESP8266 by default – you have to import the coding libraries yourself. But it's not too difficult, provided you follow the basic steps.

First, open up the Arduino IDE software (we're using version 1.6.13 – download the latest from arduino.cc/download). Then, from the menu,

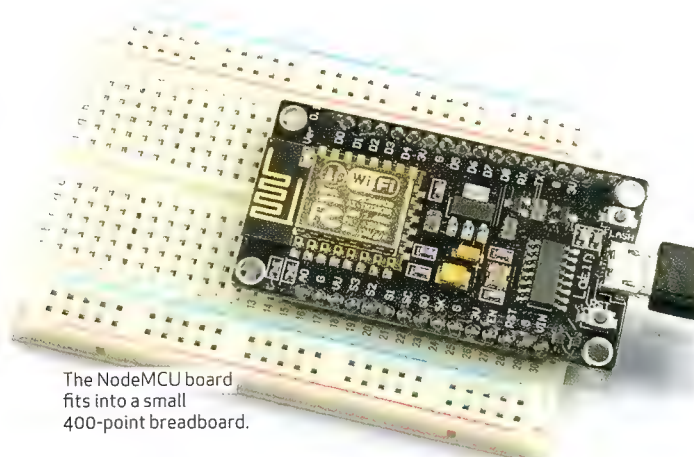
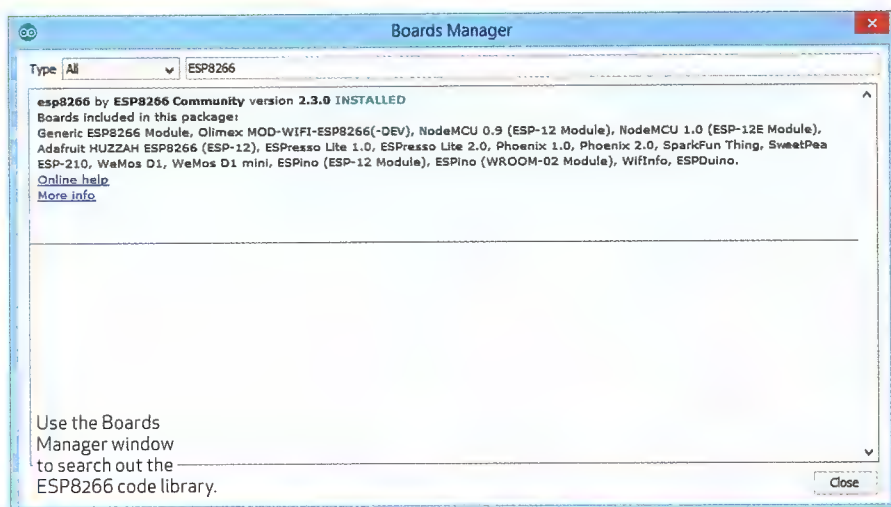
select File > Preferences and in the textbox next to 'Additional Boards Manager URLs', add in:

`http://arduino.esp8266.com/stable/package\_esp8266com\_index.json`

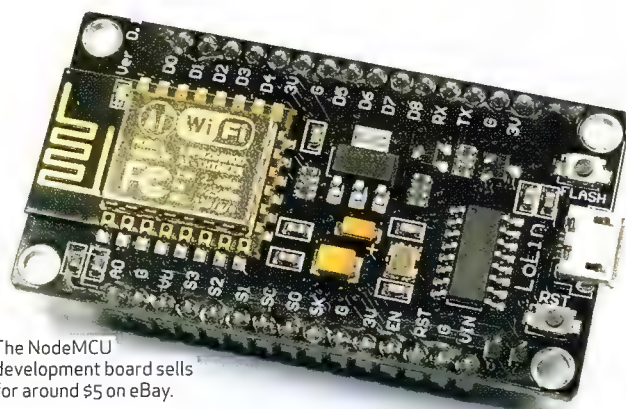
If you already have URLs in that textbox, just add a comma (,) on the end, followed by the above URL. Click the OK button when you're done.

IMPORT ESP8266 BOARD DETAILS

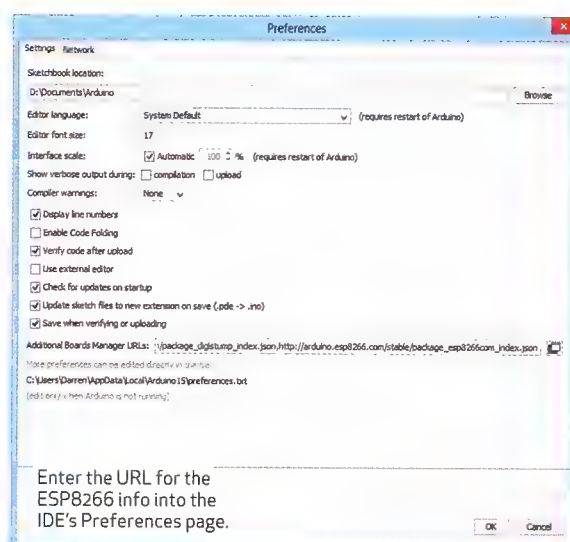
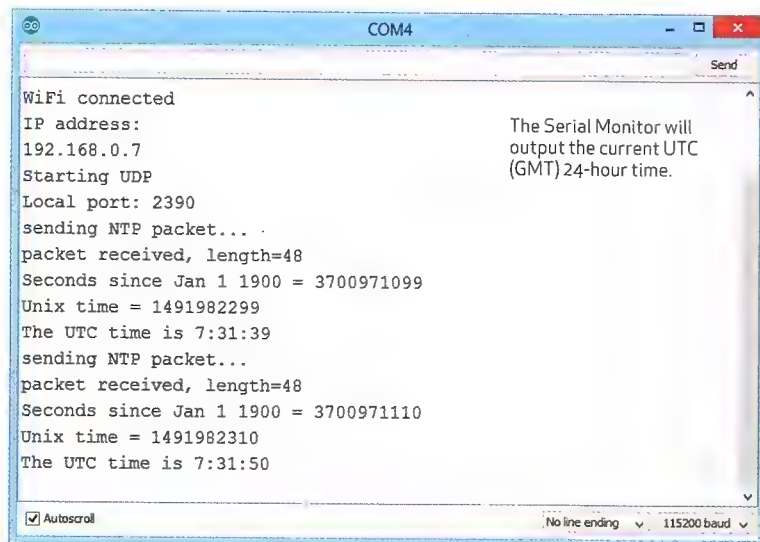
That tells the Arduino IDE where to get the latest ESP8266 board details; now we have to go get 'em. Again from the menu, select Tools, come down to 'Board: xxxxx' (where 'xxxxx' will be some



The NodeMCU board fits into a small 400-point breadboard.



The NodeMCU development board sells for around \$5 on eBay.



Arduino board listed), click on that entry and choose 'Boards Manager' from the pop-up menu. Type 'ESP8266' into the search box of the new 'Boards Manager' window and look for the 'esp2866 by ESP8266 Community' entry. Move your mouse over the entry and click on the Install button. When you're done, click Close.

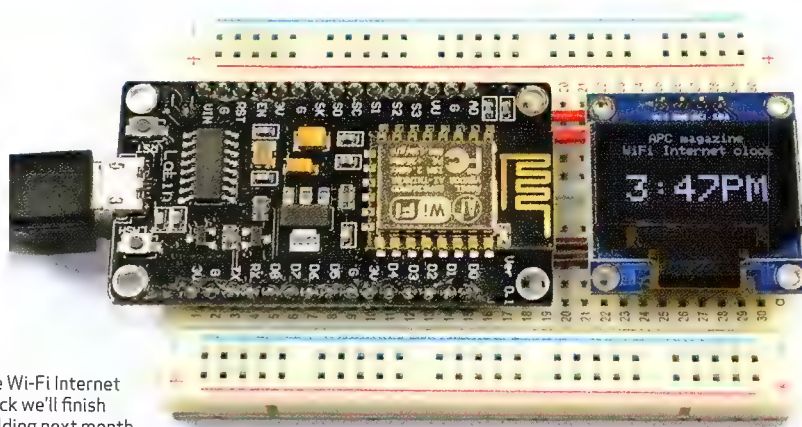
At this point, you'll need to close down all open copies of the Arduino IDE and restart it (this is so the new library can be included).

NETWORK TIME PROTOCOL

If you wanted to know the time back in pre-PC days, you'd dial '1194' and hear 'George the talking clock' tell you, 'at the third stroke, it will be three, forty-seven and twenty seconds – beep, beep, beep'. Today, there are few IT systems that don't require the ability to timestamp and while computer systems might not dial '1194', they're very likely doing the 21st century digital equivalent.

Network Time Protocol (NTP) is a network standard used to synchronise the clocks of computer devices to within milliseconds and it works a little like 'George' using a 'client/server' model. Your device is the 'client' and sends a request to an NTP 'server' for the time, the server sends the information back in Coordinated Universal Time (UTC) format, or what you might recognise as 'Greenwich mean-time' (GMT).

NTP is now a worldwide project where several thousand servers are set up to provide a free service of telling the current UTC time. They're grouped into 'pools' allowing load-sharing, so that no one server cops the brunt of every device requesting time data. Australia has its own NTP pool at 'au.pool.ntp.org' – but head there with your browser and you'll just be redirected (eventually) to the ntp.org project website. To get the actual time in a more efficient manner, we need an NTP client.



The Wi-Fi Internet Clock we'll finish building next month.

MAKING AN NTP CLIENT

An NTP client sends of a formatted request to an NTP server via the User Datagram Protocol (UDP), which sends back a 48-byte datagram with the UTC time embedded. You can get started with your NodeMCU dev board quickly by using the existing 'NTPClient' file you'll find in the Arduino IDE – no electronics required: just plug the USB cable into the NodeMCU board. From the IDE menu, select File > Examples, scroll down to 'ESP8266WiFi' and load up the 'NTPClient' app.

This app is great for testing your NodeMCU board as there's only one thing you need to do, and that's enter the SSID and password of your wireless network into the source code. After that, you're ready to flash it to the board. Just plug the board into your PC or laptop via a USB port with a microUSB cable and again from the menu, select Tools > Boards, scroll down and select 'NodeMCU 1.0 (ESP-12E module)'.

Now again, choose Tools > Port and select the 'COMx' option that isn't 'COM1' (that's your mouse). If you have more than two COM options, remove any other Arduino device you may have connected.

With the board connected and selected, upload the code to the board by choosing from the menu Sketch > Upload and watch the blue LED flash on your NodeMCU board while the code uploads.

At the top-right of your IDE, there's a small green 'magnifying glass' icon – that launches the Serial Monitor. Click it and the 'COMx' window should launch. At the bottom-right of the window, there's a drop-down box setting the Baud data transfer rate – set this to '115200'. Give the board a few seconds and it should begin to detail its activities, including printing the current UTC time even 10 seconds.

NEXT TIME...

We reckon there are some issues with this code – for starters, the NodeMCU Wi-Fi modem is powered up continuously and the code hits the NTP pool every 10 seconds: and no matter where you are, the NTP time always comes back as UTC time.

But with a little extra work, we can convert UTC time into your local time zone, add a small OLED display, reduce the power consumption and create an auto-set Wi-Fi internet clock.

We'll cover how next month. ■

Doing maths with Python

Not great with numbers? Don't worry, Python is. Darren Yates delves into Python's module of mathematical functions to begin solving almost any problem.

There's a lot of talk about STEM (Science, Technology, Engineering, Mathematics) education in schools at the moment. A recent Federal Government report found that school enrolments in these subjects are at 20-year lows (tinyurl.com/lxduqto). Given how crucial these areas are to our future, the report is alarming.

If we had to pick which of these areas was most important, we think the choice is easy – mathematics. Why? Without mathematics, the other three areas couldn't exist (tinyurl.com/lywfnro). But while maths isn't everyone's cuppa, it's something computers excel at and Python is loaded with functions and modules designed to help solve practical maths problems.

THE 'BIG FOUR'

Starting at the very beginning, the four basic maths functions or 'operators' are addition (+),

subtraction (-), multiplication (*) and division (/). You can try these out in the Python Shell:

```
print(2+5)
print(18/3)
print(15.2-6.4)
print(5.4*3)
```

ARITHMETIC PRECEDENCE

You don't have to be on LinkedIn, Twitter or Facebook for long before you get the inevitable maths brainteaser quiz that goes something like this:

$$4 + 10 / 2 - 2 \times 3 = ?$$

Getting the right answer relies on knowing what's called 'arithmetic precedence' or 'order of operations' – either way, it's the order in which the operators must be calculated. That basic order is division (/) and multiplication (x), followed by addition (+) and subtraction (-).

Get Python

Grab the latest version of Python for your operating system (Windows, Linux, Mac OS X) from www.python.org/downloads. We're using the latest version 3.x, so choose that rather than version 2.x.

You may even remember 'BODMAS' from school – Brackets, Orders, then Division, Multiplication, Addition, Subtraction as before.

In this example, we start with 4, but instead of adding '10', we have to calculate the division operator first, so $10/2 = 5$. Add the '5' to the '4' and you get 9. Continuing on, we can't subtract the '2' as the following multiplication operator takes precedence, so we get $2 \times 3 = 6$. Now we subtract the '6' from '9' and get 3. Try this out in Python Shell:

```
print (4 + 10 / 2 - 2 * 3)
```

And you should end up with '3.0'.

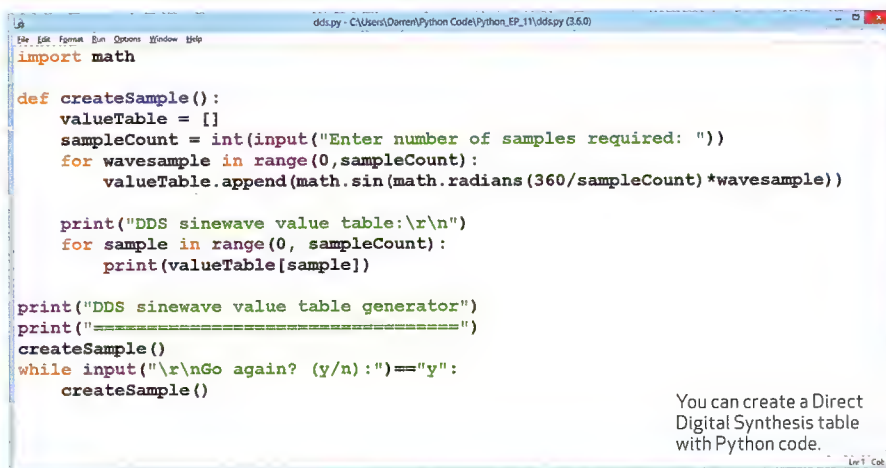
COMPUTERS CAN'T ADD UP?

We give computers a lot of credit for working out all sorts of problems, but there are limitations – and those limitations are easier to see than you might expect. We store numbers in variables of a particular datatype – whole numbers or 'integers' are stored in 'integer' variables, decimal or 'real' numbers are stored in 'floating-point' variables.

Fire up Python Shell again and try out the following:

```
print(0.1 + 0.1 + 0.1 + 0.1 +
0.1 + 0.1 + 0.1 + 0.1 + 0.1 +
0.1)
```

The answer you'd expect is '1.0'. The answer you'll get is '0.9999999999999999', which obviously isn't the same thing. Now instead of assuming computers are stupid and can't add up, the reason for this has to do with the way computers store real numbers. The basic problem is that, while we talk and think in decimal numbers (factors of 10 or



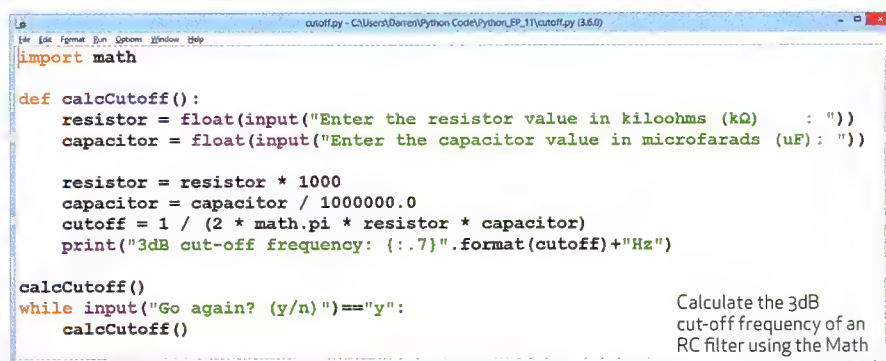
```
import math

def createSample():
    valueTable = []
    sampleCount = int(input("Enter number of samples required: "))
    for wavesample in range(0, sampleCount):
        valueTable.append(math.sin(math.radians(360/sampleCount)*wavesample))

    print("DDS sinewave value table:\r\n")
    for sample in range(0, sampleCount):
        print(valueTable[sample])

print("DDS sinewave value table generator")
print("=====")
createSample()
while input("\r\nGo again? (y/n):")=="y":
    createSample()
```

You can create a Direct Digital Synthesis table with Python code.



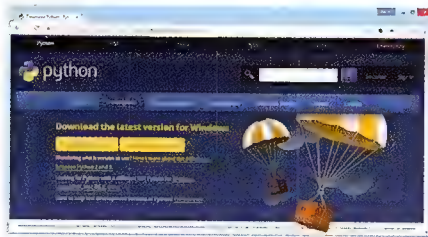
```
import math

def calcCutoff():
    resistor = float(input("Enter the resistor value in kilohms (kΩ): "))
    capacitor = float(input("Enter the capacitor value in microfarads (μF): "))

    resistor = resistor * 1000
    capacitor = capacitor / 1000000.0
    cutoff = 1 / (2 * math.pi * resistor * capacitor)
    print("3dB cut-off frequency: {:.7f}".format(cutoff)+"Hz")

calcCutoff()
while input("Go again? (y/n):")=="y":
    calcCutoff()
```

Calculate the 3dB cut-off frequency of an RC filter using the Math



Python is a free coding language available for Windows, Linux and Mac OS X.

'base-10'), computers are binary – zeros and ones. Very briefly, a decimal floating-point number can look like this:

-3.24 x 10⁻⁴ (ED: the -4 is superscripted)

You can store this number in a standard 'single-precision' 32-bit floating-point variable, but it has to store the three parts of that number – the sign (positive or negative), the significant digits or 'mantissa' (3.24) and the exponent (10⁻⁴). To do that in 32-bits, those bits have to be split – the most significant bit stores the sign, the next 8-bits store the exponent and the final 23-bits, the mantissa. But the result is binary approximations of decimal numbers.

By contrast, positive and negative integer 'base-10' numbers can easily be represented in binary and using a clever technique called 'two's complement', both the sign and the number can be stored precisely. This extra complexity in storing real numbers is also likely one of the reasons why integer operations on computers are, more often than not, faster than floating-point operations.

To fix this floating point sum error, you can use the `math.fsum()` function, where `math.fsum(0.1, 0.1, 0.1)` will equal 0.3 all day. Here's another one to try:

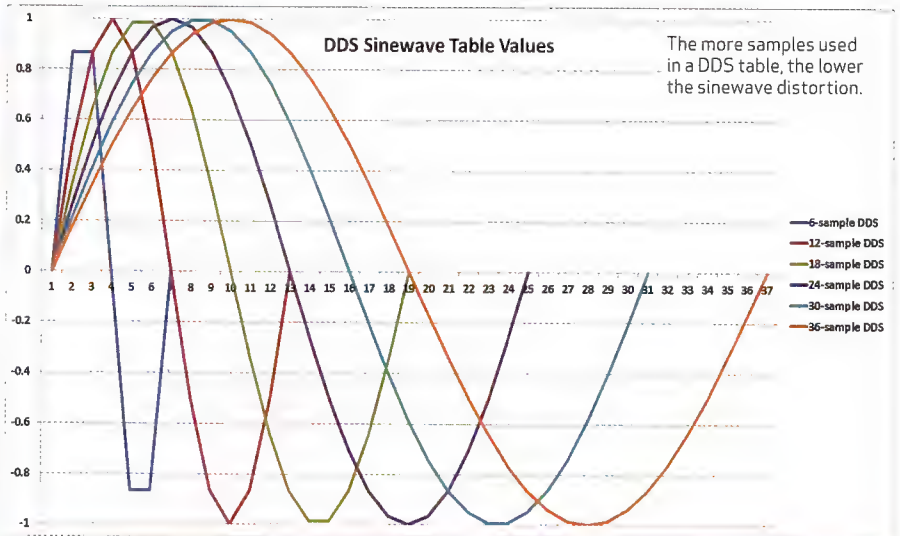
```
print(0.2 + 0.2 + 0.2 == 0.6)
```

This asks Python to tell us whether or not the equation in the brackets is true (`==`). Surprise, the answer Python returns here is 'false', again, because, as before, the binary equivalent of each '0.2' is an approximation and added together, they don't exactly equal the binary equivalent of '0.6'.

PYTHON'S MATH MODULE

Python itself only has a basic set of built-in maths functions – most of the fun stuff is stored separately in the 'math' module also included in Python, but to implement it, you must import it into your code using:

```
import math
```



```
Python 3.6.0 Shell
Python 3.6.0 (v3.6.0:41df79263a11, Dec 23 2016, 07:18:10) [MSC v.1900 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> print(4 + 10 / 2 - 2 * 3)
3.0
>>> print(0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1)
0.9999999999999999
>>> |
```

Adding up decimal numbers isn't as easy as it might seem.

```
import math
choice = 10
gravity = 9.8

def kickVelocity(distance, theta):
    return math.sqrt((distance * gravity) / math.sin(math.radians(2*theta)))

def kickDistance(velocity, theta):
    return (velocity * velocity * math.sin(math.radians(2*theta))) / gravity

def kickTheta():
    return float(input("Enter the initial vertical kicking angle in degrees: "))

while (choice > 0):
    choice = int(input("Choose: [1] kick velocity, [2] kick distance, [0] quit: "))
    if (choice == 1):
        distance = float(input("Enter the drop-kick distance in metres: "))
        theta = kickTheta()
        print('\nInitial kicking velocity: {:.5}'.format(kickVelocity(distance, theta))
              + 'm/sec\n')
    elif (choice == 2):
        velocity = float(input("Enter the kick velocity in metres per second: "))
        theta = kickTheta()
        print('\nKick distance: {:.5}'.format(kickDistance(velocity, theta))
              + 'metres\n')
    quit()
```

Calculate the football kick velocity and distance with various Math functions.

```
Python 3.6.0 Shell
Python 3.6.0 (v3.6.0:41df79263a11, Dec 23 2016, 07:18:10) [MSC v.1900 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> print(ceil(12.65))
Traceback (most recent call last):
  File "<pyshell#0>", line 1, in <module>
    print(ceil(12.65))
NameError: name 'ceil' is not defined
>>> print(math.ceil(12.65))
Traceback (most recent call last):
  File "<pyshell#1>", line 1, in <module>
    print(math.ceil(12.65))
NameError: name 'math' is not defined
>>> import math
>>> print(math.ceil(12.65))
13
>>> print(math.floor(12.65))
12
>>> print(math.floor(-12.65))
-13
>>> print(math.ceil(-12.65))
-12
>>> |
```

Don't forget to import the Math module to use trig-based functions.


```
Python 3.6.0 Shell
File Edit Shell Debug Options Window Help
Python 3.6.0 (v3.6.0:41df79263a11, Dec 23 2016, 07:18:10) [MSC v.1900 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:\Users\Darren\Python Code\Python_EP_11\cutoff.py =====
Enter the resistor value in kilohms (kΩ) : 2.2
Enter the capacitor value in microfarads (uF): 0.01
3dB cut-off frequency: 7234.316Hz
Go again? (y/n)y
Enter the resistor value in kilohms (kΩ) : 0.008
Enter the capacitor value in microfarads (uF): 470
3dB cut-off frequency: 42.32844Hz
Go again? (y/n)n
>>>
```

Enter resistor and capacitor values to calculate the 3dB cut-off frequency.

```
Python 3.6.0 Shell
File Edit Shell Debug Options Window Help
Python 3.6.0 (v3.6.0:41df79263a11, Dec 23 2016, 07:18:10) [MSC v.1900 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:\Users\Darren\Python Code\Python_EP_11\dds.py =====
DDS sinewave value table generator
Enter number of samples required: 18
DDS sinewave value table:
0.0
0.3420201433256687
0.6427876096865393
0.8660254037844386
0.984807753012208
0.984807753012208
0.8660254037844387
0.6427876096865395
0.3420201433256689
1.2246467991473532e-16
-0.34202014332566866
-0.6427876096865393
-0.8660254037844384
-0.984807753012208
-0.9848077530122081
-0.8660254037844386
-0.6427876096865396
-0.34202014332566943
Go again? (y/n):
```

The dds.py code creates a DDS table to any sample count you choose.

$$d = (v^2 \times \sin(2\theta)) / g$$

...where 'd' is the distance travelled, 'v' is the initial velocity, theta (θ) is the initial projection angle off the ground and 'g' is gravity (9.8 metres per second-squared). Rearranging the equation so that 'v' is the subject, we get:

$$v = \sqrt{(d \times g) / \sin(2\theta)}$$

...where 'sqrt' is the square-root. Now we're ready to create a small Python app.

Download the source code for this month from our website (apcmag.com/magstuff) and unzip it, then open up the Python IDLE editor and load 'dropout.py'. You'll see we've included both of these equations, to calculate either the required speed given the distance and angle, or the distance given the initial speed and angle.

The key to the code is the math module's 'sqrt()', 'sin()' and 'radian()' functions. The 'math.sqrt()' function takes the square-root of the supplied parameter, the 'math.sin()' calculates the sine of the given value. However, this function expects to see the value in 'radians', not degrees. One radian is (180/π) degrees, but rather than do the conversion by-hand, Python includes the 'math.radians()' function, which converts degrees into radians more accurately. You'll see by embedding the math.radians() function inside the math.sin() function, we send the output of the radians() function immediately as input to the sin() function and get the right result.

DIRECT DIGITAL SYNTHESIS

In electronics, a popular new method for generating sinewaves is 'direct digital synthesis' and it's used in everything from radio transmission to music synthesisers. It takes a table

This is true even if you're just mucking around in the Python Shell, but from then on, you can use the module functions as you like – and there are plenty to play with, including in other modules.

One common need is the rounding of real numbers, or turning real numbers into integers. Say, for example, you have a real number '12.65'. You may decide you want to round it up to 13, or you may want to round it down to 12. Try these in the Python Shell:

```
print(math.ceil(12.65))
print(math.floor(12.65))
```

The first returns the 'ceiling' integer of 12.65 (i.e. 13), while the second returns the 'floor' integer, which, in this example will be '12'. In other words, 'math.ceil()' rounds up to the nearest integer, while 'math.floor()'

rounds down to the nearest integer. Negative numbers give the impression of working in reverse – 'floor' gives you the next integer towards minus-infinity and 'ceil', the next towards zero, but it makes sense.

GOAL-LINE DROP-OUT

Let's try something more practical. In rugby league, a goal-line drop-out is taken when a player drop-kicks the ball from underneath the cross-bar on the try-line down the field towards the opposition try-line. These days, a typical drop-out travels 50 metres on the fly (before the first bounce). Using the math module and some projectile motion theory, we can get Python to calculate the initial velocity required to kick the ball that distance. The mathematical equation for the maximum horizontal distance travelled is:


```
Python 3.6.0 Shell
Python 3.6.0 (v3.6.0:41df79263a11, Dec 23 2016, 07:18:10) [MSC v.1900 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> import random
>>> random.seed(4)
>>> print(random.random())
0.23604808973743452
>>> print(random.random())
0.1031660342307158
>>> print(random.random())
0.396058242610681
>>> random.seed(4)
>>> print(random.random())
0.23604808973743452
>>> print(random.random())
0.1031660342307158
>>> print(random.random())
0.396058242610681
>>> |
```

Replicate the same random-number sequence by using random.seed().

```
Python 3.6.0 Shell
Python 3.6.0 (v3.6.0:41df79263a11, Dec 23 2016, 07:18:10) [MSC v.1900 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> print (2 + 2 + 2 == 6)
True
>>> print (0.2 + 0.2 + 0.2 == 0.6)
False
>>>
```

Python needs help to determine equality of decimal numbers.

of values that represent a single sinewave cycle and then clocks those samples through a digital-to-analog converter (DAC) at a particular rate, the clock rate determining the output sinewave frequency. For example, if you have one complete sinewave cycle stored as 1,000 digital samples and play those samples through a DAC at the rate of 1,000 samples per second (1,000Hz), it'd take one second to output that complete cycle, so the output frequency of that sinewave would be one cycle per second or 1Hz.

But if we played out those 1,000 samples at the rate of 1MHz (1,000,000Hz), it would take only one millisecond to play the stored cycle, giving an output frequency of $1/0.001 = 1,000\text{Hz}$. Now I don't want to have to calculate the sinewave value table for all 1,000 samples by hand, so we'll get Python to calculate it instead.

Go the source code zip file again and this time, load up 'dds.py'. What we need in this example is to divide a full sinewave into 1,000 discrete values. If you remember back to school maths, a full sinewave cycle occurs over a 360-degree range, so if we divide that 360-degrees into 1,000 steps and store away the sine value of each one in turn, we'll have our DDS value table.

In fact, our dds.py source code goes a step further by allowing you to enter the number of samples you require and generating a value table based on that sample count, printing the values to the console. If you copy and paste the table values into Excel, you can create a simple line chart showing

the sinewave the table generates – we've done this over 6, 12, 18, 24, 30 and 36 samples and as you might expect, the more samples you create, the greater the sinewave accuracy (the smoother it looks).

FREQUENCY RESPONSE

One of the more basic things you learn in electronics is how to make a circuit element called a 'filter' using just a resistor and a capacitor – connected one way, the circuit allows high-pitched frequencies to pass and progressively blocks lower frequencies; connected the other way, it's 'vice-versa'. Either way, there's a simple mathematical formula governing how the basic resistor-capacitor or 'RC' filter works:

$$3\text{dB cutoff-frequency} = 1 / (2 \times \pi \times R \times C)$$

where 'pi' is 3.1415..., 'R' is the resistor value in ohms and 'C' is the value of capacitance in farads. The cutoff point is the frequency at which the signal amplitude drops by 3dB from its peak (beyond the 3dB point, it falls away at the rate of 6dB per octave).

Load up 'filter.py' from the source code zip and you'll find a simple 3dB frequency calculator that uses the math.pi constant. Python has a number of math module constants including Euler's constant 'e' (math.e, 2.718...) and math.tau or π^2 .

To make the app easier to use, we've set the input required to

kiloohms ($k\Omega$) and microfarads (μF), which are much common units (at least for audio-frequency work) than standard 'ohms' and 'farads'.

RANDOM NUMBERS

Random numbers are a vital part of most computer games – they create the 'randomness' in the action you need for a game not to become too predictable. They're also important to computer security, but you need to understand how they work in Python, especially their limitations.

Python's 'random' module is separate from the math module and uses a random number generation algorithm called the 'Mersenne Twister' to create floating-point random numbers between 0.0 and 1.0. However, they're not strictly 'random' – the Mersenne Twister algorithm will eventually begin repeating itself, although not until after $2^{19,937}$ iterations. Even so, that makes the Python 'random' module a 'no-go' for security applications. Here, Python recommends you use the 'secrets' module instead.

But one particularly useful feature with the random module is the ability to seed the random number progression, enabling you to create a repeatable random number series, useful in debugging and data mining. For example, run the code:

```
random.seed(4)
print(random.random())
print(random.random())
print(random.random())
```

And then run it again. Note the two sets of random numbers generated – they should be exactly the same. If you don't start random() with a seed, Python will use the current time as a seed instead, ensuring the random number stream won't repeat for some time.

The other thing that random() does is produce pseudo-random numbers that are of 'uniform distribution' – that means any number between 0.0 and 1.0 is equally likely to be chosen.

But there are many other distribution 'shapes' you can generate, including triangular, betavariate, expovariate and Gaussian, all useful for statistical applications.

GIVE IT A GO

Whether it's in science, technology or engineering, mathematics really is a fundamental part of life – and with Python's collection of maths-based modules, you can quickly incorporate all sorts of mathematical functions into your apps. ■

downtime

GAME EDITOR CARMEL SEALEY

✓✓✓
apc
RECOMMENDS

Andromeda's planets are far more open than those of the original trilogy.

PC, PS4, XO | \$99.95 | WWW.MASSEFFECT.COM

Mass Effect: Andromeda

BioWare's latest sci-fi saga is a thrill Ryder, but it doesn't quite reach for the stars.

Why give credit to an electrifying 30-40-hour sci-fi adventure when we can obsess over wonky lips and dead-eyed expressions? The High Court Of Internet Rage has reached its verdict: *Mass Effect: Andromeda* is rubbish because the facial animation isn't up to *Uncharted* levels.

Of course, *Andromeda* isn't rubbish. It's actually a damn good *Mass Effect* game... albeit a compromised one. Whether it's a by-product of BioWare losing key people, or the studio struggling to get to grips with DICE's Frostbite 3 engine, the final game lacks the polish you'd expect from a triple-A EA title. Yes, lip-syncing is frequently off, and there's an overall plainness to the visuals that can make it look drab, but that shouldn't be your main takeaway.

Andromeda wisely packs its bags, and leaves Shep, the Normandy... hell, it leaves the

entire Milky Way behind. In an effort to expand humanity's horizons, the Andromeda Initiative is formed before the Reaper attacks of Shepard's story. Entire races board Arks (massive spacefaring colonies), and sent hurtling through the cosmos towards a system called the Heleus Cluster. Said region is reported to contain 'Golden Worlds', a set of mineral-rich planets ripe for colonisation.

Cue a 600-year trip that involves a whole heap of cryo sleep. The game opens on a primarily human Ark, the Nexus, just as it's being rudely awoken from centuries of space slumber.

A gun-heavy tutorial places you in the role either Scott or Sara Ryder, and after meeting (and shooting) some Kett, *Andromeda* swiftly crowns you 'Pathfinder'. After that, your 40-hour robot-shooting, planet-mining, alien-bonking journey commences.

Andromeda spins itself out

in dozens of directions. While you obviously have to tackle story missions in a specific order, the game never rushes you, often actively encouraging you to lose yourself in its side content. There are so many optional quests to leisurely pursue, it'd be daft to focus on blitzing the main campaign.

Monoliths are like *Mass Effect*'s take on dungeons – stuffed with puzzles and platforming sections, requiring Ryder to break out their awesome boost jump. The platforming bits are great. Pity we can't say the same about breaking into these sodding structures by playing a minigame of space Sudoku. Gunfights continually challenge you to dash and vault your way out of hairy situations. Without question, this is the best fighting has ever been in *Mass Effect*. It's a joy. Every weapon in the game can be tweaked with a variety of tactical mods, scope and

stock upgrades. Ryder's biotic skills are terrific, too. The only real fault with the system is being limited to three skill slots.

Exploring is almost as enjoyable as fighting. The Nomad makes the simple act of moving between mission markers a pleasure and is the best in-game vehicle *Mass Effect* has produced. The scenery that rolls into view is also impressive.

Many moments with your crew feel forced, yes, with dialogue that's tiresomely try-hard but BioWare injects lots of flavour into the Pathfinder's lines. In the end, *Mass Effect: Andromeda* is far from the shuttle crash some would have you believe.

■ Dave Meikleham

Verdict

This game kicks off what's likely to be a new trilogy with an interesting, fresh premise and great combat.





PC, PS4, XO | \$45.95 | WWW.LEGO.COM/EN-AU/WORLDS

Lego Worlds

The sky isn't the limit, your imagination is.

Creating a virtual world builder is a brave move. Not only does it require a considerable amount of technical wizardry and player dedication, it also puts you in competition with *Minecraft*, one of the most popular games on the planet.

On paper, this looks like just the game to topple the competition. Lego has the brand name and reputation for creating all manner of wondrous inventions from its humble blocks. Its humour-packed adventure games already have a huge following, and this latest instalment offers an experience even closer to the spirit of the brand. Unfortunately, it can't quite nail the execution.

Building is at the core of *Lego Worlds*, but rather than being exclusively a content creation title, Traveller's Tales has seen fit to bolster the crafting experience with some story elements. After crash-landing on a strange planet, your first task is to collect gold bricks to repair your damaged rocket. Well, we say 'your first task', but it's really the only task, as the whole game revolves

around exploring different planets in order to amass more gold bricks. Gather a hefty 100 and you'll earn the much-coveted title of Master Builder, with the freedom to create your very own worlds.

Each level is procedurally generated but has a distinct theme. One minute, you're going gung-ho in the Wild West, and the next, you're kicking back with some prehistoric folk or trying not to toast your toes on a volcano. As an inevitable compromise for the level of freedom they offer, the levels themselves lack the aesthetic panache of previous *Lego* games such as *Marvel Super Heroes* and *Jurassic World*. There are no on-rails or carefully guided sections here; instead, it's a huge sandbox world that allows you to create anything that crosses your mind, but also requires a fair amount of resources.

Worlds are brimming with inhabitants in need of aid, who will reward your services with valuable items like bricks, studs (the game's equivalent of currency), and blueprints (for creating new items). However, the missions you're faced with don't attempt to expand your

proficiency with the game's creation mechanics. Instead, gameplay outside of the construction aspect involves fairly basic tasks, like gathering pigs for a farmer.

Sometimes, your hunt for gold bricks is as simple as searching a chest or fending off some unsavoury individual. What building-focused aims there are see you utilising basic skills to construct various structures, like a home for a polar bear or a tree lodge for an elven maiden. Even with the vast differences between worlds the noticeable repetition and woeful lack of imagination when it comes to quests ensure that tedium is inevitable. What's more, *Lego Worlds* lacks much of the charm and humour of its licensed predecessors.

While it won't entice many of fans away from *Minecraft*, it does offer a solid alternative to virtual world building. ■ Anne-Marie Coyle

Verdict

Offers near-limitless freedom to build, but fidgety controls and repetition tarnish this game's potential.



Bayonetta

Platinum's ultra stylish hack'n'slasher is finally available on PC

PC, PS3, 360, Wii U | US\$19.99
WWW.PLATINUMGAMES.COM

It took nearly eight years, but *Bayonetta* is finally available to play on PC. And despite originally releasing on Xbox 360 and PlayStation 3 back in 2009, this is still one of the best hack'n'slash action games around. And this PC version is now the best version you can buy, offering 4K support and smooth, stable framerates. This is how you port a classic. Summing up the plot seems futile, because *Bayonetta* is about a witch with guns strapped to her stiletto heels who can eat angels with her hair. Things only escalate from there. *Bayonetta* offers one of the best combat systems around. You have a basic punch and kick attack, and they're used to execute any of a myriad of possible combos based on the weapon you have equipped. The dodge is a masterpiece. *Bayonetta* is all about flow. The style and fluidity of the attack chains is astonishing. Ultimately, Platinum has put in the work to create combat systems that feel great, but that also interlock into something more than the sum of their parts. When you're in the flow, the combat feels like an extension of *Bayonetta*'s character. As a protagonist, she's not just cocky and unflappable, but looks like she's having fun throughout. There are a couple of quirks to the port, but, overall, it's an absolute joy. ■ Phil Savage





Thimbleweed Park

Something strange is going on in town.

PC, PS4, X0, IOS, ANDROID
\$29.95 | WWW.THIMBLEWEEDPARK.COM

Federal agents Ray and Reyes are investigating a murder in the remote rural town of Thimbleweed Park. None of the locals seem to know anything about it, or even who the victim is. The agents have a checklist of tasks to complete, including identifying the body and finding the murder weapon. But it won't be easy, because this is a point-and-click adventure game. Untangling a single problem can span several hours, and the objects you need are often small pieces on opposite ends of a huge, elaborate jigsaw. The game uses a *Monkey Island*-style verb buffet: use, give, pick up, push and so on. Each character has a to-do list in their inventory, which gives you directions without being explicit. There's no hint system, but the game strikes a fine balance between giving you clues and refusing to help you in any way, which makes solving a particularly tricky puzzle enormously satisfying. You will get stuck, of course, but the game's open structure meant we encountered few genuine brick walls. It lacks some of the warmth and charm of *Monkey Island*, and relies a little too much on sarcasm over actual jokes. But the weird, colourful characters, witty dialogue and mystery kept me interested. This is one of the best modern point-and-click adventures on PC. ■ Andy Kelly



PC, PS4, X0 | \$49.95 | WWW.PLAYTONICGAMES.COM

Yooka Laylee

A decent, cheerful platformer — but for nostalgics only.

When Playtronic commenced a Kickstarter campaign for *Yooka-Laylee* in 2014 — a spiritual successor to the N64 *Banjo-Kazooie* games, fans were eager for a 3D platformer which would capture the glory of the mid-1990s era. And capture it they have, though arguably with a few ingredients intact that not even diehards of the period would miss.

This bright, cheerful and cheeky platformer does indeed evoke the breezy collect-a-thon vibe of the early years of 3D gaming, but it also inherits some shortcomings — most glaringly an uncooperative camera and, more

subjectively, a tedious approach to exposition. Indeed, like *Banjo-Kazooie*, dialogue is delivered with a cacophonous dirge of grunts and sighs rather than speech, vaguely funny in 1998 when it was a necessity, but in 2017, it's frankly a right pain in the tit.

Push through the more annoying facets and *Yooka-Laylee* is great for those looking for 3D hunt-and-collect platforming. The duo of Yooka and Laylee move fluidly and the special platforming abilities they gather (such as high jumps, floating and so on) are a lot of fun to use, only it's a shame they aren't available right off the bat. The worlds fit into the usual platformer templates (green, red, snow

and, uh... casino), and there are minigames, too, which can be played competitively with friends. Oh, and the quizzes from the original *Banjo-Kazooie* are back, too, only more frequently and, honestly, more tedious than ever before.

The mere existence of *Yooka-Laylee* points to an appetite for ye olde 3D platformers: it was Kickstarted after all. And yet it becomes clear after prolonged periods playing this game that the 3D platformer isn't a timeless genre, and that it's died for a reason. In the '90s, it showcased 3D gaming to a very enthusiastic audience, so enamoured by the concept that it barely mattered what you did in 3D worlds, so long as you had an opportunity to explore them. In 2017, the novelty of exploring 3D space has dissipated. This is one for nostalgics only. ■ Shaun Prescott

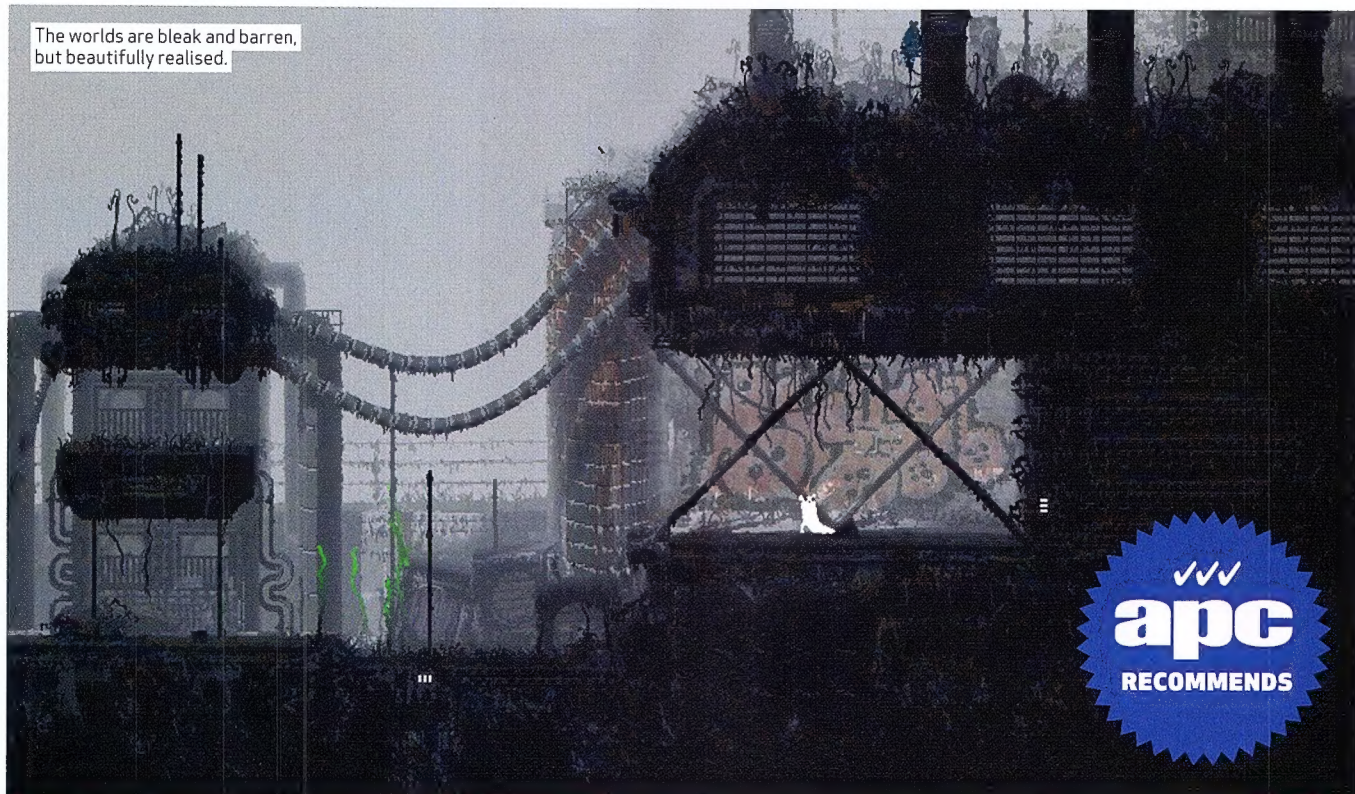


Verdict

A charming outing driven by nostalgia, but it's not quite enough in this day and age.



The worlds are bleak and barren, but beautifully realised.



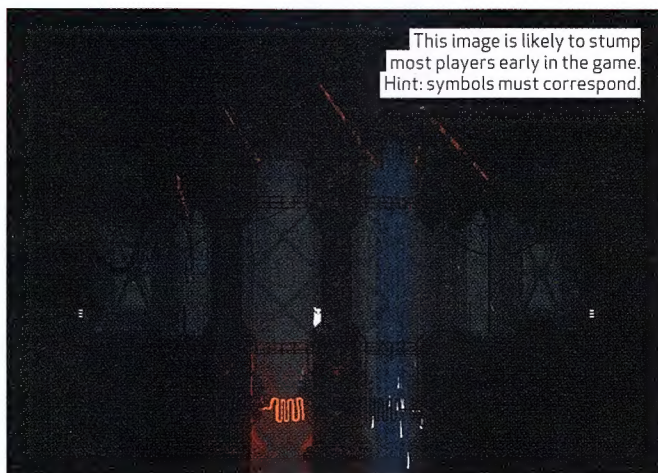
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Rain World

Help a slugcat survive in a beautiful 16-bit post-apocalypse.

Rain World is a platformer and a survival game, but neither of those categories are a neat fit for its peculiar brand of misery. There are traces of other games' DNA, such as the original *Dark Souls*' bonfire system and the roaming, improvisational foes of *Alien: Isolation*, yet *Rain World* stands apart as one of the most alienating and difficult games in recent memory, previously mentioned company included.

There's little exposition: you're a slugcat, wrestled away from its family and plunged into a decayed urban dreamscape plagued with erratic, free-roaming monstrosities that want to eat you. As a slugcat, you're close to the bottom of the food chain, but not rock bottom: you'll need to eat to survive, or more accurately, eat in order to hibernate, which must be done in special chambers that also



serve as checkpoints. There's more to learn about how *Rain World* works but I've already said too much.

The early hours will annoy anyone without steely patience: slugcat's traversal feels cumbersome and he can't jump very well, but once you get a feel for what this game is trying to do (make you feel utterly disempowered), it will feel less like bad design and more

thematically appropriate. You're a slugcat. You're nothing. You should already be dead.

Rain World will be polarising. It requires improvisation and smarts, and there's no way to trick it into being easier. The early hours are taxing, and in all honesty, the game continues to be taxing. It's not a game to wash away your daily worries with. But the variety

of the world's barren landscapes will keep the determined pushing on, and the seemingly insurmountable challenges are will eventually buckle.

You just have to be smart. You have to learn – and then very vaguely know – how to survive. You have to accept that, sometimes, you'll be unlucky. Is that too hard? For the vast majority of players, definitely.

Few will see the more remote corners of *Rain World*'s relentlessly dire stretch, but those who do are unlikely to forget the experience.

■ Shaun Prescott

Verdict

A tough 2D platformer that shares more in common with survival horror than *Mario*.





Find My iPhone(s) helps police catch thief with 130 stolen handsets

Hands to yourself, sneakthief.

While many people use Apple's Find My iPhone app to locate their device after putting it down somewhere in the house (or was it the car?), it was recently used at the Coachella Valley Music and Arts Festival in California to catch a smartphone thief. Police were first made aware of the extent of the thefts through Reddit (where victims were posting warnings), and then enlisted the help of concert-goers using Find My iPhone. After pinpointing the culprit using the app, victims alerted security who apprehended one Ronaldo De Jesus Henao on suspicion of theft. In his bag was over 130 smartphones. (How was he not over-encumbered...?)

First punch thrown in human vs robot war

KNIGHT-KNIGHT.

It takes quite a bit of strength to floor a 135kg machine, but a 41-year-old inebriated man has somehow managed it in a Silicon Valley shopping centre carpark. His victim? A 5ft-tall Knightscope K5 security robot (that looks like a giant techy Tic-Tac) tasked with scanning licence plates. While the robot was knocked to the ground and sustained minor scratches, it was happily back at work the following week, and its attacker was arrested on charges of "prowling and public intoxication". As well as monitoring cars and unusual activity with its 360° cameras, Knightscope is hoping its tin-can security guards will soon be able to detect guns.



Phone-user-friendly crossing lights

KEEPING DARWINISM AT BAY SINCE 2017. Working in the city, we know exactly how common it is to see someone walking down the street, looking at their phones and not at the things they should be. Despite the "Distracted...? Watch out, cars about!" campaign from 2015-2016, it's clear the unsafe practice is not about to stop. So what has Melbourne done to combat the dangerous use of mobile phones among pedestrians? To stop them from blindly walking out into the road at traffic lights, the city has installed "mobile-friendly" crossing lights that have been embedded into the ground to attract the downturned gaze of phone-users. These lights reflect what the little red/green man is doing, thus potentially saving the lives of many a foolish phone-user who never looks up.



Startup wants to create robot brothel in London

YOU CAN'T RESIST US, MR POWERS...

If the LSR (International Congress on Love and Sex with Robots) has taught us anything, it's that humans like to bang anything that moves, whether it's organic or not. So it comes with almost no surprise that a Spanish company named LumiDolls is looking to open a robot brothel in London. Boasting to be Europe's "first sex dolls agency", the company promises "completely realistic dolls, both in the movement of their joints and to the touch, that will allow you to fulfill your fantasies without any limits". (Note to self, suppress mental images.) LumiDolls' first venue, in Barcelona, was forced to shut down after complaints were made from real-life prostitutes, but it has since reopened elsewhere. The company now has its sights set on London and is looking for an investor.



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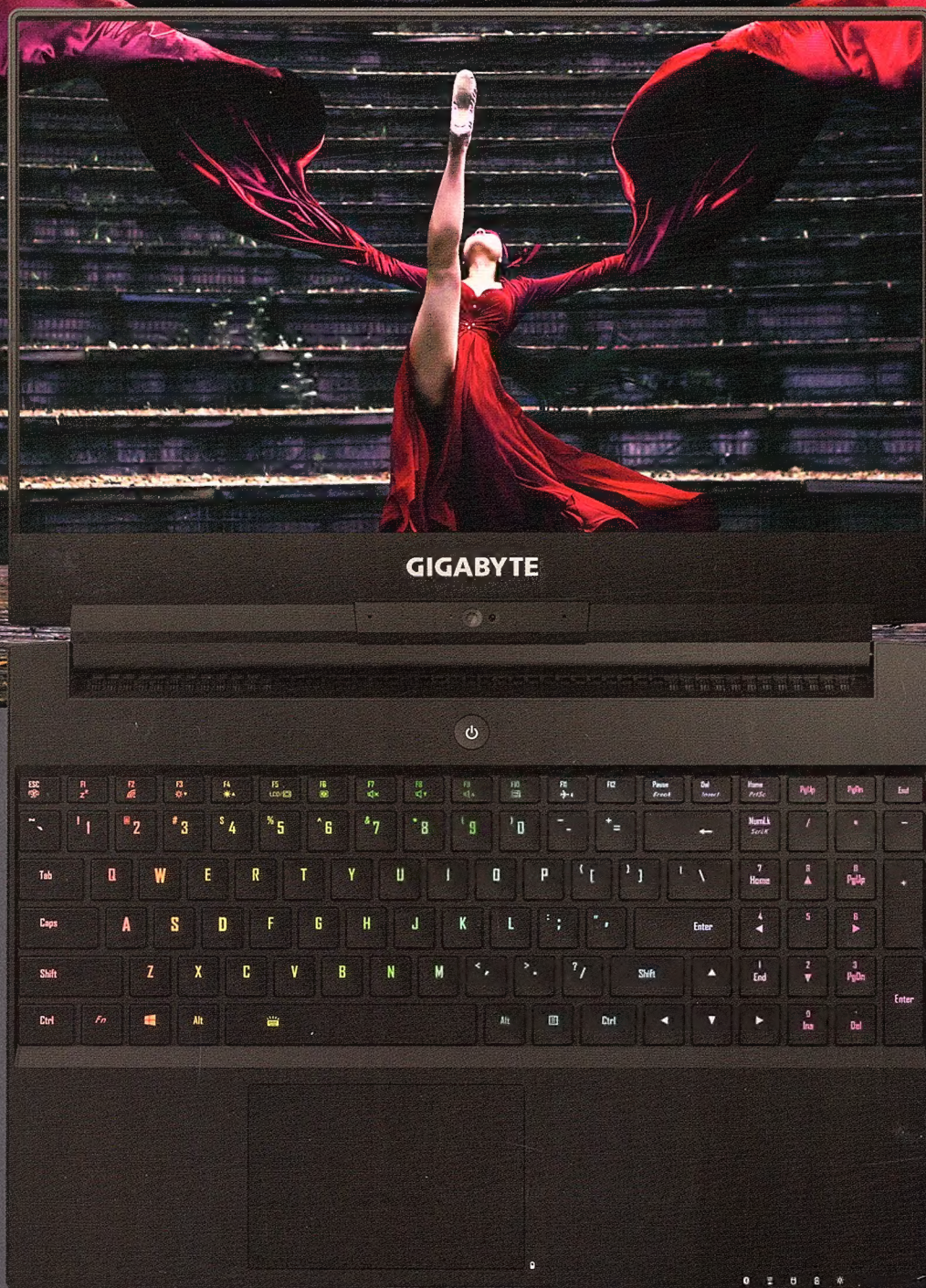
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